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Volume 18, Number 7, April 15, 1964

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Volume 18, Number 7 April 15, 1964

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

9803 (AD-404251) EXPERIMENTS WITH DROSOPHILA MELANOGASTER IN MAGNETIC FIELDS. Perry Close and Dietrich E. Beischer (Naval School of Aviation Medicine, Pensacola, Fla.). Aug. 1, 1962. 10p.

No genetic effects were observed in Drosophila on exposure to homogeneous and inhomogeneous magnetic fields of high field strength and gradient. Synergistic effects of magnetic fields in combination with x radiation, starvation, hyperoxia, and hypoxia were also not observed. (auth)

9804 ADVANCES IN BIOLOGICAL AND MEDICAL PHYSICS. VOLUME VIII. Cornelius A. Tobias and John H. Lawrence, eds. Advan. Biol. Med. Phys., 8:(1962). New York, Academic Press, 1962. 463p.

Separate abstracts were prepared on 6 papers included in this volume. One paper was previously abstracted and appeared in NSA. (C.H.)

For abstracts of individual papers see: 9805, 9839, 9975, 9976, 9977, and 11543.

9805 MECHANISMS OF CARCINOGENESIS. Niels Arley and Reidar Eker (Norwegian Radium Hospital, Oslo). Advan. Biol. Med. Phys., 8: 375-436(1962).

Theories of carcinogenesis are reviewed. Data are discussed from studies on the induction of tumors by chemical agents, viruses, ultraviolet radiation, radioisotopes, and ionizing radiations. Possible experimental techniques of attack on macromolecular problems of the mechanisms of carcinogenesis are discussed. Various theoretical models of carcinogenesis are considered, with emphasis on radio-induced carcinogenesis. (172 references.) (C.H.)

9806 IMMUNIZATION IN SCHISTOSOMIASIS BY PREVIOUS EXPOSURE TO HOMOLOGOUS AND HETEROLOGOUS CERCARIAE BY INOCULATION OF PREPARATIONS FROM SCHISTOSOMES AND BY EXPOSURE TO IRRADIATED CERCARIAE. Elvio H. Sadun (Walter Reed Army Medical Center. Inst. of Research, Washington, D. C.). Ann. N. Y. Acad. Sci., 113: 418-39(Dec. 30, 1963).

A review on immunization in schistosomiasis indicates that immunization is certainly possible. Mice can be protected much more readily against S. japonicum than against S. mansoni. However, the Rhesus monkeys develop an acquired resistance to S. mansoni. Rats can also be easily protected with worm homogenates of S. mansoni. It has also been observed that a previous exposure to a Formosan heterologous strain of S. japonicum induced a greater degree of resistance than exposures to the Japanese homologous strains. The least significant degree of acquired immunity is induced by vaccination with worm homogenates or worm products and with the transfer of serum from immune to normal animals. It was also indicated that exposure of monkeys to irradiated cercariae induced a marked resistance to a subsequent challenge of nonattenuated cercaria of S. mansoni. 67 references are included. (P.C.H.)

9807 METHODS IN IMMUNOCHEMISTRY OF VIRUSES. 3. SIMPLE TECHNIQUES FOR LABELING ANTIBODIES WITH I^{131} AND S^{35}. R. G. Webster, W. G. Laver, and S. Fazekas de St. Groth (Australian National Univ., Canberra). Australian J. Exptl. Biol. Med. Sci., 40: 321-8 (1962).

Methods for labeling antibody with S^{35} and I^{131} are described. The final product is serologically unaltered and thus suited to the study of immunologic interactions in dilute systems or in microquantities. The described iodination procedure involves the combination of iodine with tyrosyl and, to a smaller extent, histidyl residues of the protein, and the concomitant liberation of hydrogen iodide. Carrier 0.001 M KI (0.25 ml) was mixed with carrier-free radioiodide, the volume brought up to 3.5 ml with distilled water and acidified with 0.2 ml N H_2SO_4. Iodine was liberated by the addition of 0.2 ml of H_2O_2 (100 volumes), and the reaction mixture was shaken with 2.0 ml CCl_4 at intervals for 30 min to extract the free iodine into the organic phase. The aqueous phase was then removed and the CCl_4 washed. Serum globulin, buffered at pH 8.9 with 0.1 M bicarbonate buffer, was added to the washed CCl_4 and mixed immediately. This globulin-CCl_4 mixture was gently agitated for 10 min, the 2 phases separated by centrifuging, and the aqueous phase dialyzed against running tap water for 12 hr and finally against saline for 1 hr. As a result of the procedure described above, 20% of the input radioactivity was bound to protein. This amounts to 0.05 μmoles of iodine per 11.95 mg protein and hence to one atom of iodine per 3.96×10^{-16} mg protein, or 0.71 atoms of iodine per antibody molecule. The S^{35} label was incorporated into rabbit antibody by feeding the animals, during maximum antibody synthesis, S^{35}-labeled methionine and cystine obtained from Escherichia coli grown in a medium containing sulfate-S^{35}. On the fifth day after boosting rabbits for the third time with 5000 hemagglutinating doses of swine influenza virus a S^{35}-amino acid-containing hydrolyzate was injected intravenously. The rabbits were bled 24 hr later and the serum separated and stored at −15°C. About 43% of the label present in the bacteria was recovered in the amino acid fraction after hydrolysis of the protein and, as-

suming a recovery of 50 ml of serum from the rabbit, 3.5% of the injected label was incorporated into serum proteins. The biological properties of the antibody were identical with those of unlabeled antibody. Thus, internal labeling of antibody with S^{35} offers a cheap source of tagged antibody, chemically indistinguishable from unlabeled antibody, which has a reasonably long half-life (87.1 days). However, this method is somewhat more complex and, as with all in vivo methods of labeling antibody, over 99% of the activity is incorporated into other proteins. The major disadvantage of using I^{131} as a radioactive label is its relatively short half-life (8.1 days); but as the reagent is obtainable carrier-free and is inexpensive, it is possible to attain almost any desired level of radioactivity without increasing the degree of iodination beyond a single radioactive atom, on the average, per protein molecule. The other disadvantage inherent in this general method of labeling is that the labeled molecule is not chemically identical with the original and that more than 1 or 2 atoms of iodine per antibody molecule can alter the immunological reactivity.(BBB)

9808 FISSION FRAGMENT TRACKS AS URANIUM TRACERS IN BIOLOGICAL ELECTRON MICROSCOPY. A. G. Malmon (National Institutes of Health, Bethesda, Md.). Biophys. J., 4: 1-10(Jan. 1964).

Fission fragment tracks from uranium-stained biological preparations were observed in the electron microscope in a study of the feasibility of their use as tracers. Virus, DNA, and tissue sections were stained with U, prepared for electron microscopy, irradiated in the high thermal neutron flux of a nuclear reactor, and examined without further treatment in the electron microscope. Support films of 50 to 100 A of silicon monoxide and a conventional shadow layer of Cr revealed distinct fission fragment tracks with no other discernible damage to the specimen. Virus and DNA specimens were irradiated to 3×10^{18} n/cm^2 (thermal) and tissue sections to 3×10^{16} n/cm^2 (thermal). About $^1/_4$ of the calculated number of fissions left detectable tracks. It is estimated that the position of a U atom on a DNA fibril may be determined to 50 A, and a U atom in a virus preparation or tissue section to about $^1/_2$ μ. (auth)

9809 X-RAY DOSE AT THE QUANTUM LIMIT. C. W. Smith (Downside School, Eng.). Brit. J. Radiol., 37: 78 (Jan. 1964).

A method is described for calculating the x-ray dose that is required for the detection of a small object under quantum-limited conditions. The fundamental limit is expressed in terms of measurable parameters. (C.H.)

9810 DIFFERENTIAL LABELLING OF TRILLIUM CHROMOSOMES BY H^3-THYMIDINE AT LOW TEMPERATURE. Ashraful Haque (Univ. of Dacca, Pakistan). Heredity, 18: 129-33(May 1963).

Root meristems of Trillium erectum were treated with a solution containing 2 μC/ml H^3-thymidine for 16 hours at 22°C. Following this treatment the plants were allowed to grow at this temperature for a period of 24 hours and finally kept at 1°C for 5 days. Slides were made from the plants for autoradiographic study of the chromosomes. The autoradiographs of metaphases showed the euchromatic chromosomal segments to be fully labeled and the starved heterochromatic regions to be devoid of the label. Thus the low temperature induced cytologically observable differentiation between the eu- and heterochromatic segments of the chromosomes, which is due to a true and selective loss of the DNA from the heterochromatic regions. (auth)

9811 THE DESIGN OF EXPERIMENTS ON MUTATION RATES. J. B. S. Haldane (Genetics and Biometry Lab., Bhubaneswar, Orissa). J. Genet., 58: 232-6(Mar. 1963).

In order to get the best assurance that two mutation frequencies differ, or the best estimate of their ratio, the number of gametes tested in a series of experiments should vary inversely as the square root of the expected mutation frequency. In order to get the best estimate of the difference of two mutation rates it should vary directly as the square root of this frequency. (auth)

9812 BACTERIOPHAGE-INDUCED MUTATION IN ESCHERICHIA COLI. Austin L. Taylor (Brookhaven National Lab., Upton, N. Y.). Proc. Natl. Acad. Sci. U. S., 50: 1043-51(Dec. 1963). (BNL-7386)

A new temperate bacteriophage (phage Mu1) of E. coli strain K12 is described. Sensitive bacteria infected with Mu1 exhibit increased forward mutation rates at many gene loci. The prophage of Mu1 is always closely linked to the chromosomal sites of phage-induced mutation. It is proposed that loss of genetic functions is a direct consequence of phage integration at functional loci. The potential uses of this system for studying the mechanism of integration are discussed. (auth)

9813 A METHOD FOR ESTIMATING THE AVERAGE BONE-MARROW DOSE FROM SOME FLUOROSCOPIC EXAMINATIONS. A. Liuzzi, S. H. Blatz, and M. Eisenbud (New York Univ., New York). Radiology, 82: 99-105(Jan. 1964).

A method is described for relating the incident radiation dose distribution to the average active bone marrow dose. The method consists essentially of dividing the incident exposure field into contiguous subfields and then calculating a set of subfield parameters that will relate the average entrance dose within each of these divisions to an average marrow dose. Summation of the contributions from all subfields yields the average marrow dose for the entire examination. An application to posterior-anterior exposures in a gastrointestinal series is described. (C.H.)

9814 RADIATION DOSES RECEIVED IN MYELOGRAPHIC EXAMINATIONS. R. H. Rohrer, Perry Sprawls, Jr., W. B. Miller, Jr., and H. S. Weens (Emory Univ., Atlanta). Radiology, 82: 106-12(Jan. 1964).

The radiation exposures to the spleen, the third lumbar vertebra, and to the ovarian regions during 58 myelographic examinations of the cervical and lumbar spine with image intensification were determined. The use of a system which records the operation of the fluoroscope makes possible not only the measurement of these doses in phantoms, but also a study of the procedures followed by the fluoroscopist in the course of myelographic examinations. It was found, in the cases studied, that cervical examinations led to a greater contribution of radiation dose to the ovaries, spleen, and third lumbar vertebra than had been anticipated. Large doses are sometimes encountered because of extended use of the fluoroscopic beam during the injection of contrast medium and its removal from the subarachnoid space. Wide variations in critical organ doses were encountered. On the average, large doses appear to be caused by the use of large field areas and prolonged operating periods of the fluoroscope. The average exposures to the organs studied range from 1.84 r to 1.06 r, while, in certain examinations, exposure doses less than 100 mr and as high as 5 r are reported. (auth)

9815 RESEARCH IN THE MEDICAL AND LIFE SCIENCES. p.3-138 of "Fundamental Nuclear Energy Research." Washington, D. C., GPO, 1963.

Some of the more important advances in the beneficial applications of radiation and radioisotopes, cancer research, somatic effects of radiation, toxicity of radioelements, radiation genetics, combating detrimental effects

of radiation, molecular and cellular research, health physics, instrumentation, fallout, and atmospheric radioactivity are summarized. (D.C.W.)

Ecology

9816 RESEARCH FOR THE CONTROL OF RADIOACTIVE POLLUTANTS. E. C. Tsivoglou (Robert A. Taft Sanitary Engineering Center, Cincinnati). J. Water Pollution Control Federation, 35: 242-59(Feb. 1963).

Laboratory and field research studies on the α radioactivity in streams due to natural radioactivity or contamination by the uranium milling industry are discussed. The use of special photographic emulsions for the identification and counting of α-emitting radioisotopes in various kinds of samples, the use of gross α radioactivity analysis of environmental samples of all types as an indicator of pollution from uranium mill wastes, and the leaching of Ra^{226} from spent uranium are solids deposited in river beds, and results of in-plant surveys of uranium mills for an evaluation of the waste potential of the different processes of uranium extraction are discussed. Results are summarized from field studies on radioactive pollution from uranium mills in streams of the Colorado River Basin and a survey on the fate of P^{32} and Zn^{65} in the Columbia River as a result of radioactive waste disposal practices at the Hanford works. (C.H.)

9817 ENVIRONMENTAL RADIATION STUDIES. p.139-80 of "Fundamental Nuclear Energy Research." Washington, D. C., GPO, 1963.

Some studies on nuclear test sites, plant and animal systems, soils, soil-plant relations, and marine organisms, systems, and phenomena are summarized. (D.C.W.)

Metabolism, Tissue Distribution, and Toxicology

9818 (EUR-474.e) STUDIES ON THE DISTRIBUTION OF TRACE ELEMENTS IN A MOLLUSK FROM A FRESHWATER ENVIRONMENT, BY ACTIVATION ANALYSIS. F. Girardi and Margaret Merlini (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1963. 26p. (CONF-384-1)

From Symposium on Radioactivation Analysis and its Application to the Biological Sciences, Saclay, France, Sept. 1963.

A semi-automated system for the determination of trace elements in biological materials by means of activation analysis is described. The system is based on the chemical separation of elements in the irradiated specimens by chromatographic procedures; automatic gamma spectrometry, with the use of sample changers; and automatic treatment of the experimental data by computer techniques. The biological results obtained on Unio, a bivalve from Lake Maggiore, revealed the presence of elements never before determined in a mollusk from a freshwater environment. (C.H.)

9819 BONE COMPOSITION AND Ca^{45} RETENTION IN FOWL AS INFLUENCED BY EGG FORMATION. S. Hurwitz (National and University Inst. of Agriculture, Rehovoth, Israel). Am. J. Physiol., 206: 198-204(Jan. 1964).

Calcium-45 was administered intravenously to laying hens close to the time of ovulation. Groups of five birds were killed at intervals ranging from 30 min to 14 days, after dosing, and Ca, P, and radioassays were made on their blood plasma, on ends and cortical and medullary segments of their tibias and femurs, and on eggs laid previous to killing. Radioactivity in blood plasma and eggs decreased with time. There were no significant changes in amount and Ca and P content of tibia and femur segments during one and more reproductive cycles. Radioactivity of bone segments increased to 2 hr after dosing and later markedly declined, paralleling eggshell deposition. Specific activity of the medullary segment was higher than that of ends or cortical segment. It is suggested that the decline in radioactivity of bone is caused mainly by exchange with stable Ca during its transfer from gut to eggshell, although resorption of bone may also take place. The high specific activity of medullary bone 2 days after dosing suggests a greater turnover of Ca in this segment than in the other segment studied. (auth)

9820 A COMPARISON OF THE RELEASE OF I^{131} FROM SALINE, REPOSITORY, AND VITELLINIC INJECTION SITES. Irwin Caplin, John T. Haynes, and Eric Lang (Methodist Hospital, Indianapolis). Ann. Allergy, 21: 380-7(July 1963).

A comparison of the release of I^{131} (100 μC/ml vehicle) from subcutaneous injection sites in guinea pigs was made. Injections of I^{131} in saline were compared to shielded (vitellinic) and unshielded emulsified injections of I^{131}. After 2 days, no detectable I^{131} was present in the saline injection sites. Detectable amounts were present in both the shielded and unshielded repository injection sites after 13 days. There was an extremely rapid loss of I^{131} from injections in saline. In 14 hr, 87% of the I^{131} had been removed from the injection site; 45% was removed from the unshielded emulsion site in 14 hr, while only 11% was lost from the shielded emulsion site. The higher body temperature of guinea pigs (100.2°F) may account for the rapid absorption. Injections of guinea pigs with I^{131} in saline and in mineral oil emulsions revealed a fixing of the I^{131} at the injection site by the emulsified injection. No detectable I^{131} was present after 2 days when saline was used as the vehicle. Emulsified injections showed fixing of I^{131} at the injection site after 12 days. Taking into account the half life of I^{131} (8.07 days), there is fixing of I^{131} at the site for at least 30 days. A comparison of the release obtained in 14 hr showed the marked superiority of repository injections in fixing I^{131} at the injection site and the superiority of vitellinic shielded repository injections over unshielded repository injections. (TCO)

9821 THE EXTENT AND CONSEQUENCES OF THE UPTAKE BY PLANTS OF RADIOACTIVE NUCLIDES. R. Scott Russell (Agricultural Research Council Radiobiological Lab., Wantage, Berks, Eng.). Ann. Rev. Plant Physiol., 14: 271-94(1963).

A brief summary is presented of current knowledge on the sources and extent of radiation to which the world population has been exposed. The role of plants in the transfer of radionuclides from the environment to man is considered; with emphasis on the characteristics of radioactive substances that cause them to be important sources of internal radiation. Isotopes considered in detail include Sr^{90}, I^{131}, Cs^{137}, Ra^{226}, Ra^{228}, Th^{232}, Th^{228}, C^{14}, and Pu. (96 references.) (C.H.)

9822 METABOLISM OF I^{131} BY THE ENDOSTYLE AND NOTOCHORD OF AMMOCOETES UNDER DIFFERENT CONDITIONS OF TEMPERATURE. Margaret Clements-Merlini (Columbia Univ., New York). Gen. Comp. Endocrinol., 2: 240-8(Apr. 1962).

Ammocoetes larvae (Petromyzon marinus), kept at 2 different temperatures (20 and 30°C), were injected with I^{131} and sacrificed at intervals from 2 to 120 hr. The endostyles of animals kept at 20°C concentrated

more I^{131} than the notochords of the same animals, on an equal wt basis. At 30° the notochords eventually sequestered a higher percentage of the isotope than the endostyles. Uptake of I^{131} by both the notochord and the endostyles was affected by changes in temperature. Higher temperature reduced the accumulation of the isotope by a factor of 10 in endostyle, and by a factor of 7 in notochord. The peak concentration of I^{131} was reached earlier under these conditions by both tissues. Radiochromatograms of hydrolyzates of endostyles from larvae kept at 30° showed the presence of labeled thyroid hormones 2 hr after injection of I^{131}. At 20°C labeled thyroid hormones were demonstrable 12 hr after administration of isotope. The data confirm that the early appearance of thyroid hormones at relatively higher temperature is a matter of increased metabolism. (BBB)

9823 USE OF URANYL ION IN MEMBRANE TRANSPORT STUDIES. Vincent P. Cirillo and Peter O. Wilkins (Seton Hall Coll. of Medicine and Dentistry, Jersey City, N. J.). J. Bacteriol., 87: 232-3(Jan. 1964).

The use of uranyl nitrate, a nonpenetrating transport inhibitor, which inhibits both sugar influx and efflux, was used in an analysis of sugar transport in baker's yeast. Using uranyl nitrate, transport can be stopped immediately at any predetermined interval and washing can be carried out after all the samples have been collected. It was found that the cells could be kept for more than 1 hr in 10^{-3} M uranyl nitrate at room temperature without sugar loss. The technique is described. (P.C.H.)

9824 MICRODISTRIBUTION AND OTHER ERROR COMPONENTS OF C^{14} PRIMARY PRODUCTION ESTIMATES. R. Morrison Cassie (New Zealand Oceanographic Inst., Wellington). Limnol. Oceanog., 7: 121-30(Apr. 1962).

Four experiments were carried out to partition the error components of C^{14} primary production measurements into those associated with errors of technique and those due to real spatial variations in production. A well-stirred, bacteria-free culture of Skeletonema costatum was sampled to measure the minimum error obtainable by the technique. Each sample was divided into two aliquots which were incubated separately to give a measure of error. The minimum coefficient of variation was found to be approximately 10%, both in the Skeletonema cultures and in natural populations. This is greater than would be expected from purely physical errors of technique or from chance variations in the number of organisms. It is suggested that a large component of the error is attributable to random variations in the photosynthetic capacity of the phytoplankton, possibly induced by disturbances in handling the samples. This is supported by the fact that there was a systematic difference in production between the first and second aliquot, the second usually being the higher. Results showed clearly that real variations of production could be detected between samples even within the relatively small spatial scale of sampling. From the autocorrelation, it would appear that any two water samples more than 10 cm apart are likely to show a significant difference in productivity. The frequency distribution of in situ production estimates is at least approximately log-normal. Hence statistical tests based on the normal distribution can best be made on log-transformed data. (auth)

9825 SOME PHYSICO-CHEMICAL PROBLEMS POSED BY THE USE OF RADIOACTIVE COLLOIDS. R. Marignan (Université, Montepellier, France). Minerva Nucl., 7: 441-6(Nov. 1963). (In Italian)

The definition of colloid is examined, and the distinctive features of colloids are compared with macromolecules. An account is given of the various methods used to prepare colloids, with particular reference to certain biological aspects of these preparations, namely their stability, the size of the colloid particles, the polydisperse nature of the colloids, etc. Mention is made of research undertaken which should throw further light on the fate of colloids introduced into the human body. (auth)

9826 REMARKS RELATIVE TO THE PREPARATION OF A STABLE COLLOIDAL SUSPENSION OF CHROMIUM PHOSPHATE. Pierre Lerch (Institut de Radiophysique Appliquée, Lausanne, Switzerland). Minerva Nucl., 7: 451-4(Nov. 1963). (In Italian)

Attempts to obtain stable radioactive $CrPO_4$ colloidal suspensions are reviewed. The principles of an easily reproducible method are illustrated. The findings of chemical and radiochemical analysis show that chromium and phosphate ions are fixed at different levels on gelatin. The colloid is therefore not formed purely from $CrPO_4$ micelles but probably from a more complex compound incorporating gelatin. A description is given of the behavior of colloidal $CrPO_4$ suspensions injected into the blood stream of the rabbit. An exponential disappearance curve is obtained. The organs in which $CrPO_4$ accumulates, notably the liver, are listed. (auth)

9827 THE INTERNAL DOSIMETRY OF RADIOCOLLOIDS. Giorgio Scarpa and Ernesto Casnati (CNEM, Casaccia, Italy). Minerva Nucl., 7: 496-509(Nov. 1963). (In Italian)

The specific characteristics of internal dosimetry are described, and the theoretical grounds for and fundamental formulas of the empirical-mathematical method of dose calculation for punctiform, laminar, and spherical sources are considered. The physical and biological parameters which appear in these formulas are listed and the accuracy of their practical assessment and the errors in dose due to errors of measurement are analyzed. The maximum and probable differences between the calculated and actual doses are assessed. (auth)

9828 CONTRIBUTION TO RADIOTOXICITY ESTIMATION OF LUMINOUS RADIOACTIVE PAINTS. J. Halík. Pracovni Lekar., 15: 419-22(Dec. 1963). (In Czech)

Luminous radioactive paints used at present in Czechoslovakia contain up to 70 mg of Ra^{226} in 1 kg of paint. Elution in a buffered solution at pH 3 showed that about 72% of Ra becomes separated from the luminophore within the first two hours. These values were ascertained in Czechoslovak-made RSB 3 as well as in the Swiss-made L8 paints. It is estimated that the toxicity of these paints in peroral contamination approaches the toxicity of a solution of pure Ra salts. The necessity for appropriate hygienic conditions for the work with these paints is stressed. (auth)

9829 CESIUM IN LIRIODENDRON AND OTHER WOODY SPECIES: ORGANIC BONDING SITES. Gregory N. Brown (Oak Ridge National Lab., Tenn.). Science, 143: 368-9(Jan. 24, 1964).

In trees labeled with Cs^{137}, the isotope in the sap streams is primarily in the free ionic form. Much ionic Cs^{137} also appears to occur in intracellular fluids other than the sap streams. However, a small quantity of Cs^{137} forms ionic bonds with organic compounds (probably as salts of carboxylic acids). Even though most of the activity appears in the phloem tissue, some activity in dispersed in much of the sapwood and even in the dead xylem tissue of the heartwood. Some of this Cs^{137} is retained, at least temporarily,

by the numerous carboxylic groups of the natural plant compounds of cell walls, cytoplasm of living cells, and cell debris of heartwood. (auth)

9830 THE RESORPTION RATE OF RADIOACTIVE Na AND CHANGES AFTER EXPERIMENTAL LIGATION OF THE VENA FEMORALIS OF RABBITS. M. Wiedemann. Thesis, Dresden, Medizinische Akademie, 1962. 50p. $2.00(Gmelin, AED-DISS. 62-462).

Resorption of an intramuscular depot of Na-24 in rabbits with ligated Vena femoralis is studied. Resorption rate decreases immediately after ligation and increases after 12 hr. Average clearance constants are given. Possible explanations are discussed. (Gmelin Inst.)

Radiation Effects

Refer also to abstract 11457.

9831 (AD-403109) EFFECTS OF RADIATIONS ON CELL DIVISION AND CHROMOSOMES IN ANIMALS. Final Report No. 2, December 15, 1961–December 14, 1962. Sajiro Makino (Hokkaido Univ., Sapporo, Japan). Contract DA-92-557-FEC-34462. 12p.

Effects of radiations on cell division and chromosomes in animals were studied. Effects of x and beta irradiations on grasshopper spermatocytes were investigated using various chemicals with special regards to their radioprotective effects. The effects of single or repeated x irradiation on chromosomes of human in vitro cell line were studied. Genetic studies of anomalies in the mouse populations whose ancestors received x irradiation were investigated. Effects of x rays on the spermatogenesis of Drosophila were studied and the effects of gamma irradiation on mating of Paramecium were studied using P. polycarium which has the binary mating type. Many new clones were obtained by the application of gamma irradiation. These clones were very useful to analyse the genetic behavior of Paramecia. Immunological response of lethally irradiated mice which receive injection of heterologous spleen cells was studied. Histological observations on spleens were carried out as a supplemental experiment. The effects of x irradiation on the pregnancy rate in mice after polyovulation treatment were investigated. (auth)

9832 (AD-403354L) I. INFLUENCE OF TOTAL-BODY X-RAYS ON THE KINETICS OF ERYTHROCYTE ENZYMES AS A BIOLOGICAL DOSIMETER. II. BIOCHEMICAL STUDIES OF THE RAT BRAIN. Annual Progress Report III, June 1, 1962 to May 31, 1963. Donald A. Rappoport (Texas. Univ., Galveston. Medical Branch). Contract DA-49-193-MD-2139. 49p.

An internal x ray dosimeter was found in a rat erythrocyte enzyme, nucleoside phosphorylase. At all total-body x ray doses tested from 100 to 1000 r, this enzyme was inhibited but the rate of inhibition was closely similar for the 250, 500, 750, and 1000 r in the postirradiation interval from 0 to 48 hr. However, the time and degree of recovery of enzyme activity postirradiation were dose dependent. Thus, complete recovery after 100 r was in 116 hr, after 250 r in 155 hr, and after 500 r in 221 hr. With a 750-r dose only partial recovery of activity was noted at 216 hr, but at 1000-r dose there was no recovery of enzyme activity. The inhibition of this enzyme after 100 r was 31% in 48 hr; after 250 r, 59% in 72 hr; after 500 r, 73% in 96 hr; after 750 r, 75% in 96 hr; and after 1000 r, 76% in 96 hr. In the immediate postirradiation interval of 16 hr, 100-r total-body x irradiation of the rat inhibited erythrocyte nucleoside phosphorylase 14% and after 500 r the inhibition was 36%. A microtechnique was developed and initiated for testing the erythrocyte nucleoside phosphorylase activity which will permit repeated sampling of blood from rats and other subjects. This will permit using each animal as its own preirradiation control and the same animal will also be used for multiple sampling of blood throughout the postirradiation period. (auth)

9833 (AD-403866) THE EFFECT OF STERILIZING AND SUB-STERILIZING DOSES OF CATHODE AND GAMMA RAYS ON THE PROPERTIES OF BEEF AND PORK. Report No. 14 (Final), December 6, 1954–January 1, 1962. F. L. Kauffman (Swift and Co. Research Labs., Chicago). Contract QMR&D (Natick) No. 2. 16p.

In research on the irradiation of beef and pork, both at sterilizing levels and pasteurizing levels, it was noted that at pasteurizing levels, although bacterial population was reduced, the cooler shelf life of both pork and beef was not appreciably altered as compared with the control. In fact, color degradation appeared more rapidly in some instances in the irradiated samples. A comparison was made wherein three different sources of radiation were used on beef steaks and pork chops at levels of 25,000 and 100,000 rads. The samples were irradiated in polyethylene bags and tested initially and after storage at 45°F for flavor, tenderness, and bacterial population. No differences in flavor or tenderness were noted between the control and irradiated samples. After one week at 45°C all of the beef samples, including the controls, had a sour taste indicating that irradiation did not sufficiently protect this product. The pork samples held up somewhat longer; however, the controls held up as well as the irradiated product. Effects of sterilizing doses on pork and beef from a gamma source and an 8 million volt linear accelerator were compared initially and after one, three, and six months storage at 45°F. Statistical analysis of strip steak mean flavor scores indicated that the control steaks were significantly better in flavor than the irradiated steaks at each storage time. The tenderness mean scores of the irradiated steaks were very significantly higher than the control steaks. There were no significant differences between the two types of irradiation. A study was made wherein beef steaks were broiled to an internal temperature between 125 and 180°F prior to gamma irradiation at 2.8 M and 4.6 M rads. Storage tests were made at 40°F and 100°F for periods up to six months. Ionizing irradiation reduced the bacterial population in all instances to less than 10 per gram. The flavor of all irradiated samples was markedly inferior to the nonirradiated controls. Pre-cooking had little effect on the flavor scores. Those products irradiated at 4.6 M rads were slightly inferior to those irradiated at 2.8 M rads. The aroma of all irradiated steaks was greatly inferior to that of the untreated frozen controls. Precooking or amount of irradiation had little effect on the average aroma scores. Tenderness of all irradiated steaks was greater than that of the unirradiated controls. This was less noticeable in the case of steaks precooked at 180°F. Samples of ground beef were mixed with alpha tocopherol, ascorbic acid, and vitamin A prior to irradiation with gamma rays. This mixture masked some of the irradiation flavor. Heating at 140°F for 16 hr either before or after irradiation had no particular effect on the flavor scores. A reduction in irradiation flavor in beef steaks was accomplished by lowering the temperature substantially during irradiation. Irradiation at 4.5 M rads at –196°C resulted in a product having little detectable irradiation flavor as scored by an expert panel. Meat frozen at other higher temperatures

during irradiation had more irradiation flavor, but not as much as that irradiated at ambient temperature. (auth)

9834 (TID-20063) TERMINAL REPORT ON A HISTOLOGICAL STUDY OF THE MORPHOGENESIS OF ANOMALIES INDUCED IN THE LIMBS OF CHICK EMBRYOS BY X-RAYS AT DIFFERENT STAGES OF DEVELOPMENT. Richard A. Goff (Oklahoma. Univ., Norman). Dec. 1963. Contract AT(40-1)-2850. 25p.

The pattern of cell death in the limb skeleton of irradiated chick embryos is distinct from that which normally occurs. It is apparent that cell death is a factor in molding the contours of the leg in normal development. Massive necroses also occur at other sites, such as in presumptive joint regions and on contours of skeletal elements, the location of which suggests their role in development. The function of concentrations of cell death in differentiating skeletal muscle is not clear. Immediately after exposure to 600 to 800 r x radiation at all stages of development investigated, cell division was arrested. Within a day after irradiation, chromatopycnosis was general throughout the limb, with no indication of specifically sensitive sites. Following this, the cellular debris disappeared, apparently by phagocytosis, and the tissues appeared to be normal. Skeletal abnormalities were not evident until the elements began to chondrify, but affected limbs were always smaller than controls. Anomalous conditions (distoproximal reduction) induced in the early period were often indicated in the early limb bud by abnormal contours. Cell death, in most cases, did not accompany subsequent differentiation of anomalous parts. The failure of joints to form was in all instances, a result of the failure of parts to separate in their initial formation, rather than a secondary fusion. (auth)

9835 (UCRL-10979) ANALYSIS OF X-RAY-INDUCED MITOTIC DELAY IN SEA URCHIN EGGS (thesis). Bhashini Rao (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 20, 1963. Contract W-7405-eng-48. 67p.

X-ray-induced reversible mitotic delay in sea urchin eggs was studied. Detailed cytological analysis showed that sublethal doses of x rays affected the process of chromosome condensation in these eggs. The delay in chromosome condensation corresponded directly to the delay in cell division. Rate and time course of DNA synthesis in these cells were studied over two division cycles by following the incorporation of tritium-labeled thymidine. The study of radiosensitivity of DNA synthesis showed that x-ray doses that caused reversible mitotic delay had no effect on the time or rate of DNA synthesis in these cells. Furthermore, the experiments showed that delay of DNA synthesis in the second division was a result of interference with mitosis. An equation to determine the S period was derived and used to compute the S period in these cells. Variation of mitotic delay with dose and time of irradiation was studied. There existed in prophase a critical point. If cells were irradiated before this point, there was a delay in the first cleavage. Cells irradiated after this point did not show any delay in the first cleavage, but the second cleavage was delayed. Shortly before the onset of the visible prophase, there was a stage in which the delay produced by a given dose was maximum. Some experiments showing the effect of halogenated pyrimidines on cell division and the modification of this effect by radiation were described. (auth)

9836 (FTD-TT-62-355) RADIOBIOLOGY (SELECTED CHAPTERS). David Emmanuilovich Grodzenskii (Grodzenskiy). Translation from p.20-120 of "Radiobiologiya, Biologicheskoye Deystviye Ioniziruyushchikh Izlucheniy," Gosatomizdat, 1961. 119p.

Topics discussed include the radiation chemistry of water, effects of radiation in living organisms, direct and indirect effects of ionizing radiation, the target theory, the role of oxygen in radiation injuries, radiation effects on cell division, factors affecting the radiosensitivity of animals and plants, the effects of average and large doses of radiation on man, radiation effects on embryos and fetuses, the relation of radiation to cancer and leukemia, radiation effects on metabolism, radiomimetic substances, and chemical protection against radiation injuries. (C.H.)

9837 (JPRS-22778) CYTOLOGICAL ANALYSIS OF THE RADIOSENSITIVITY OF SIMILAR TISSUES IN DIFFERENT SPECIES OF MAMMALS. G. A. Chudinovskaya and O. N. Kitaeva (Kitayeva). Translated from Zh. Obshch. Biol., 24: 435-44(1963). 13p. (OTS-64-21316)

A comparison was made of the radiosensitivity of bone marrow and lymph nodes from mice, rats, guinea pigs, and hamsters. The effects of 100 r x radiation on mitotic activity of the cells at times varying from 30 min to 144 hr post-irradiation were determined by cytological examination. The radiosensitivity of bone marrow progressed from mouse through rat, hamster, and guinea pig. The radiosensitivity of lymph node cells ranged from rat, mouse, guinea pig, to hamster. The relation of the findings to survival rate of irradiated animals is discussed. (C.H.)

9838 NEUROVEGETATIVE CHANGES IN THE REACTIONS OF PERIPHERAL VESSELS AFTER X-RAY IRRADIATION. Julian Walawski and Jan Ryzewski. Acta Physiol. Polon., 14: 385-97(July-Aug. 1963). (In Polish)

Results are summarized from an investigation of the effects of 700 r x radiation on the peripheral blood vessels in dogs. Changes in vascular resistance that might be due to lesions of either the whole or a part of the autonomic nervous system or to the response of vascular muscles were investigated by the use of blocking drugs. It was concluded that changes in vascular resistance in acute radiation sickness are due to a diminution in tone of the sympathetic nervous system with simultaneous increase in that of the parasympathetic system. The ability of the vascular muscles to react to neurohormones appeared to be preserved. (C.H.)

9839 HEAVY IONS AND SOME ASPECTS OF THEIR USE IN MOLECULAR AND CELLULAR RADIOBIOLOGY. Tor Brustad (Norwegian Radium Hospital, Oslo). Advan. Biol. Med. Phys., 8: 161-224(1962).

Applications of heavy ion beams in studies on the biological effects of radiation are reviewed. The physical characteristics of heavy ion beams, dosimetry of ion beams, the relative biological efficiency of heavy ions, and linear energy transfer (LET) values along ion tracks as measured by track-segment and track-average methods are discussed. Results are reviewed from experiments on the radiosensitivity of a variety of biological systems over a wide range of LET. Emphasis was placed on the induction of effects that depend exponentially on the radiation dose rather than dose rate effects. (117 references.) (C.H.)

9840 EFFECTS OF VISIBLE AND ULTRAVIOLET RADIATION ON THE GERMINATION OF PHACELIA TANACETIFOLIA. M. Richardis Schultz and Richard M. Klein (Fordham Univ., New York). Am. J. Botany, 50: 430-4(May-June 1963).

Germination of Phacelia tanacetifolia was suppressed by exposure to white light increasing with intensity and length of illumination. The light effect decayed during 24 hr of darkness. Seeds were most sensitive to the suppres-

sive effects of light 13–17 hr after the beginning of imbibition. Light suppression was caused by a photocatalytic reaction. Wavelengths causing the suppression lie in the far-red, red, blue, near-ultraviolet, and far-ultraviolet regions of the spectrum. At equal energies, blue light was less effective than far-red, red, or ultraviolet radiation. There was no evidence for the existence of the phytochrome system. Simultaneous irradiation with red and blue light or simultaneous irradiation with red and far-red induced a synergistic repression of germination. The presentation of different wavelengths in various sequential patterns markedly altered the germination response. An interaction between elevated temperatures and visible radiation affecting germination response was also noted. (auth)

9841 HOST-RELATIONSHIPS OF RADIATIONS-INDUCED MUTANT STRAINS OF HYMENOLEPIS DIMINUTA. Arthur W. Jones, J. A. Dvorak, M. M. Hossain, J. L. Huffman, C. P. Hutchins, D. E. D. Jones, and R. L. Kisner (Univ. of Tennessee, Knoxville). Ann. N. Y. Acad. Sci., 113: 343-59(Dec. 30, 1963).

Studies on the structure and behavior of radioinduced mutant strains of Hymenolepis diminuta are reviewed. The effects of radiation upon cestodes is classified as morphological, physiological, and cytological. (P.C.H.)

9842 RADIATION EFFECTS ON MACROMOLECULES OF BIOLOGICAL IMPORTANCE. Franklin Hutchinson (Yale Univ., New Haven). Ann. Rev. Nucl. Sci., 13: 535-64(1963).

The effects of ionizing radiation are discussed for proteins, nucleic acids, lipids, and polysaccharides. Processes that take place in very dilute solutions, in concentrated solutions or living normal cells, and in dry states of the various molecules are considered. 348 references. (R.E.U.)

9843 FUNCTIONAL AND MORPHOLOGICAL CHANGES OF SOME ORGANS AND SYSTEMS DURING CHRONIC RADIATION ILLNESS. A. N. Kishovskii. Aviats. i Voenno-Morskaya Med., No. 8, 39-40(1962).

A study was made of the broncho-lung system, the gastroenteritic tract, and the lymphatic system, whose affection is of significance in the clinical picture of chronic radiation illness and its complications. Experiments were made on 218 rabbits of which 193 were irradiated with small doses (5, 10, 25 roentgens) to a total of 800, 1000, and 1500 roentgens. Twenty-five rabbits were used as controls. The animals were observed for periods from several months to three and more years. The condition of the broncho-lung system, gastroenteritic tract, and lymphatic system were studied in various stages of development of chronic radiation illness. The detailed observations and manifestations of the serious functional and morphological changes for the organs and systems, and in what stages and test conditions they were developed are given. In all systems the rise of pathologic changes were noted. For various stages of development of the illness, disturbances in one or the other systems predominated. In the initial period, disturbances of the gastroenteritic tract were more obvious, somewhat less in the broncho-lung system, and even less in the lymphatic system. In later stages, the most significant functional and morphological changes were in the broncho-lung system; in the gastroenteritic tract at this stage they were of lesser degree. The results show the significant effects on the indicated organs and systems during chronic radiation illness and the data can be useful, not only for diagnosis of chronic radiation illness, and its complications, but also for explanation of some peculiarities and their pathogenesis. (TCO)

9844 HEALING OF ENCLOSED FRACTURES OF BONES DURING CHRONIC RADIATION ILLNESS. A. B. Rusakov. Aviats. i Voenno-Morskaya Med., No. 8, 44-6 (1962).

The influence of chronic radiation illness on the course of fractures of bones was studied using two groups of 20 rabbits (control and experimental). After a right forearm fracture, the process of healing was studied clinically and roentgenologically for 3, 7, 15, 30, 45, 60, 80, 100, 120, and 140 days after the fracture for the control group. The experimental group (prior to the fractures), was exposed to small doses (20 roentgens) of x radiation for 60-62 days for a total dose of 1200 roentgens to obtain an experimental model of chronic radiation illness. After fracture, clinical tests similar to the controls were made. Experimental details for various clinical tests were presented. Comparing the experimental with the control group, it was possible to note the lag of the process of callosity for the irradiated rabbits in the first 7-14 days and then the tempo of the reparation process grew rapidly. At 21 days, the x-ray data for both were essentially similar, but later on the rebuilding of the bone callosity for the irradiated animals went even somewhat more rapidly than for the control group. With a histological study, it was established that for animals with chronic radiation illness the process of formation of the elementary bone callosity and its rebuilding were somewhat delayed. (TCO)

9845 INACTIVATION OF β-GALACTOSIDASE INDUCTION BY ULTRAVIOLET LIGHT. Arthur B. Pardee and Louise S. Prestidge (Princeton Univ., N. J.). Biochim. Biophys. Acta, 76: 614-21(Dec. 20, 1963).

The ability of Escherichia coli to form β-galactosidase (EC 3.2.1.23) is strongly inhibited (relative to total protein synthesis) by ultraviolet light if the bacteria are maintained in the same medium before and after irradiation. However, irradiation has a much smaller effect if the bacteria are transferred to a poorer medium after irradiation and before induction. High concentrations of inducer do not reverse the ultraviolet light inhibition. Ultraviolet light appears mainly to cause a catabolite repression of β-galactosidase formation, similar to action of P^{32} decay or thymine starvation, and not to inactivate the structural gene for this enzyme. Ultraviolet light inactivation of β-galactosidase induction is not an all or none phenomenon in each bacterium. Increasing doses of ultraviolet light progressively inactivate formation of the enzyme in an individual bacterium. In contrast, inactivation of galactoside permease induction is virtually complete in each damaged cell. A difference in ultraviolet light sensitivity before and after induction was noted. This is attributed to inactivation of galactoside permease, which is initially essential for β-galactosidase induction. After induction had commenced, inhibition of permease formation no longer reduced the ability of the bacteria to produce β-galactosidase. (auth)

9846 SENSITIVITY TO ULTRAVIOLET LIGHT OF SINGLE- AND DOUBLE-STRANDED DNA. H. S. Jansz, P. H. Pouwels, and C. Van Rotterdam (National Defense Research Organization TNO, Rijswijk, Netherlands). Biochim. Biophys. Acta, 76: 655-7(Dec. 20, 1963).

The ultraviolet sensitivity of ss-DNA and rf-DNA were studied using spheroplasts of E. coli K12S hcr^+ and hcr^- strains, respectively. No difference in uv sensitivity was observed when ss-DNA was assayed either on hcr^+ or on hcr^- spheroplasts. On the other hand uv-treated rf-DNA was much less biologically active when tested on hcr^- spheroplasts than on hcr^+ spheroplasts; its apparent uv sensitivity on hcr^+ spheroplasts is approximately $\frac{1}{8}$ that

of ss-DNA whereas on hcr⁻ spheroplasts the uv sensitivity of rf-DNA is approximately equal to that of ss-DNA. The results indicate that in the absence of host cell reactivation ss- and rf-DNA show equal uv sensitivity and hence that rf- and ss-DNA molecules incur an equal number of lethal hits at a given dose of uv light. Therefore, the difference in uv sensitivity between ss- and rf-DNA on hcr⁺ spheroplasts must then be ascribed to a difference in response to the reactivation mechanism of the host cell. (P.C.H.)

9847 NUTRITIONALLY DEFICIENT MUTANTS OF MARCHANTIA POLYMORPHA INDUCED BY X-RAYS. Morton W. Miller, E. D. Garber, and Paul D. Voth (Univ. of Chicago). Botan. Gaz., 124: 94-102(Dec. 1962).

Techniques for harvesting, sterilizing, and culturing gemmae of Marchantia polymorpha L. on defined and complex solid media are described. Gemmae were irradiated with increasing dosages of ultraviolet light to a maximum of approximately 51×10^3 ergs and with increasing dosages of x rays to a maximum of approximately 16×10^3 r to determine the relation between dosage and the number of normal thalli produced by the gemmae. Although the percentage of normal thalli was reduced to 63% at approximately 17×10^3 ergs, greater dosages of ultraviolet light did not result in lower percentages of normal thalli. On the other hand, the percentage of normal thalli was inversely related to x-ray dosage in the complete range tested. A random sample of 279 impaired thalli obtained from 1588 gemmae exposed to 16×10^3 r was tested for a nutritional deficiency by noting the growth of fragments from these thalli on defined and supplemented solid media. Of the twelve nutritionally deficient thalli which were found, seven required a vitamin or growth factor, four an amino acid, and one a pyrimidine. (P.C.H.)

9848 RADIOGRAPHIC CHANGES FOLLOWING THE ADMINISTRATION OF BONE-SEEKING RADIONUCLIDES. Jacob L. Fabrikant and C. L. D. Smith (Inst. of Cancer Research, Belmont, Surrey, Eng.). Brit. J. Radiol., 37: 53-62(Jan. 1964).

During investigations on the carcinogenic effects of α and β-emitting radionuclides, serial radiographs of rats injected with single and repeated doses of P^{32}, Pu^{239}, or Am^{241} were studied to record the development of radioinduced changes. Among the lesions observed were failure of longitudinal bone growth, abnormal bone moulding, pathological fractures, and the production of sclerosing, lytic, and mixed forms of osteosarcoma. The induction of bone tumors could be identified early and the development followed closely; radiographic changes are described. (auth)

9849 EFFECT OF X RAYS ON THE RESPIRATION OF BUCKWHEAT PLANTLETS (FAGOPYRUM ESCULENTUM M.) GROWING FROM SEEDS SOAKED IN WATER WITH AND WITHOUT BORON. Régis Mache (École Nationale Supérieure Agronomique, Toulouse). Compt. Rend., 257: 3649-51(Dec. 4, 1963). (In French)

Buckwheat seeds were irradiated after soaking for 15 hr in the presence of 10^{-3} M/l boron. Seeds soaked in the absence of boron were similarly irradiated. In the two cases, a temporary increase in the respiration was observed at a given x-ray dose, different for the two cases. Boron seems responsible for different physiological states to which x-ray doses stimulating respiration would correspond. (tr-auth)

9850 THE EFFECT OF GAMMA IRRADIATION OF SEEDS OF WHEAT ON RADIATION SENSITIVITY OF EXPERIMENTAL PLANTS. L. M. Fonshtein (Inst. of Genetics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 153: 933-5(Dec. 1, 1963). (In Russian)

Dry seeds of spring wheat were gamma irradiated (Co^{60}) with 4-, 8-, and 16-kr doses and planted; the seeds of the descendants were also planted, some after irradiation with 12- or 16-kr doses. Viability of the first-generation seeds was not significantly decreased by 4 kr, was decreased noticeably with 8 kr, and both viability and plant development were sharply decreased with 16 kr. When the seeds of this generation were planted, survival and plant height were lower for the irradiated than for the controls, especially when the seeds came from 16-kr irradiated parents. However, descendants of plants receiving 4- and 8-kr doses in the first generation and 12- and 16-kr doses in the second generation were the same height, with some protective effect of the first irradiation being noted. A smaller percentage of the seeds receiving 4 and 8 kr showed chromosome aberration, also indicative of protective effect. The results may be explained by an increase in exchange of substances under the effect of the irradiation, these being very basic in nature and resulting in greater radiation stability of the descendants. Selection, resulting in survival of the most radioresistant, may also be very important. Preliminary irradiation as a means of increasing resistance of plants and animals to subsequent irradiation cannot be a direct method of radiation protection. (TTT)

9851 COMPARATIVE STUDY OF RADIATION SENSITIVITY OF DIFFERENT STRAINS OF DROSOPHILA MELANOGASTER. I. E. Vorobtsova. Dokl. Akad. Nauk SSSR, 153: 943-6(Dec. 1, 1963). (In Russian)

The radiation sensitivity of seven strains of wild type Drosophila melanogaster was compared. In experiments with 50- to 500-kr irradiation doses, 100 kr was shown to be sufficient for 100% death of the flies in a time suitable for comparative studies. Averaged lifetimes of irradiated flies varied from 11.6 to 16.5 days, with statistically significant differences; the seven strains were considered classifiable into two groups: one relatively radiation resistant and the other, relatively radiation sensitive. The curves of percentage of deaths versus time were similar for all strains, the rate increasing slowly at first, then very rapidly, but slowing down again near 100% mortality. These curves are considered to reflect not so much the differences in radiation sensitivity of individuals as differences in the processes causing destruction of the flies at different times after the irradiation. Coefficients of regression were calculated for the first two parts of the curves, and showed that the average length of life and rate of dying were inversely dependent in the first part but were not obviously related in the second part. (TTT)

9852 CYTOGENETICS OF NEUTRONIC MUTANTS IN NICOTIANA TABACUM. G. S. Murty, K. V. Krishnamurty, and K. Appa Rao (Central Tobacco Research Inst., Rajahmundry, Andra Pradesh, India). Euphytica, 12: 57-68(Apr. 1963).

Three commercial varieties of flue-cured tobacco, Chatham, Delcrest, and Hicks, were subjected to irradiation by thermal neutrons at six doses. Germination of the treated seeds was good in the lowest two doses, 1×10^{12} and 2.5×10^{12} n/cm²/sec while deterioration started in 5×10^{12}, which was considered to be the threshold dose. The other three doses, 1×10^{13}, 2.5×10^{13}, and 5×10^{13} proved to be lethal. The field population of about 1200 N_1 plants was screened for pollen fertility. About 22% of the plants showed less than 80% pollen fertility and in two flower mutants there was complete absence of pollen. Chlorophyll mutants in the N_2 progeny consisted of albinas, which appeared as simple recessives in a monohybrid ratio. Morphological leaf mutants, mostly due to chromosomal aber-

rations such as single or double or reciprocal translocation and fragmentation were isolated under different leaf types. Some new leaf mutants breeding true were isolated and maintained for field performance. Flower mutants such as male sterile, yellow stigma, and split flower were isolated in the N_1, N_2, and N_3 progenies. (auth)

9853 FREQUENCY AND SPECTRUM OF MUTATIONS INDUCED BY RADIATIONS IN SOME VARIETIES OF BREAD WHEAT. C. Bhatia and M. S. Swaminathan (Indian Agricultural Research Inst., New Delhi, India). Euphytica, 12: 97-112(Apr. 1963).

The frequency and types of mutations induced by different dosages of x rays, fast and thermal neutrons, and beta particles from P^{32} and S^{35} were studied in two fully awned (C. 591 and H. 167) and two awnless strains (N.P. 809 and H. 389) of bread wheat. Phenotypic changes affecting only some of the tillers of a plant occurred in the M_1 generation. Speltoid-normal chimeras were the most frequent. From the fact that the induced change affected the whole ear and never part of an ear, it is suggested that each ear arises either from a single initial cell or a few cells that have been affected alike. Albina mutations occurred in the M_2 progenies of C. 591 but not in the others. From the varietal variation in the incidence of chlorophyll mutations, it seems likely that there are differences in the number of genes controlling chlorophyll development in different varieties. Similar types of viable mutations occurred in all varieties, the speltoid mutation being predominant. No awnless types were found in the M_2 and subsequent progenies of C. 591 and H. 167. Fully awned mutations occurred readily in the awnletted variety N.P. 809. It is suggested that the awned mutants of N.P. 809 arise from either the deletion or inactivation of the awn suppressor gene B_1. The completely awnless variety H. 389 has two epistatic genes, B_1 and B_2^s. While half-bearded mutants caused by the deletion of B_1 occur frequently in the M_2 and subsequent generations a fully bearded mutant was found in the M_3 progeny of a family that segregated for half bearded mutations in M_2. The breeding behavior of all the mutations isolated in M_2 was also followed. (P.C.H.)

9854 RELATION OF RADIATION DOSE RATE TO INCIDENCE OF NEOPLASMS IN MOUSE HEMATOPOIETIC ORGANS. S. N. Aleksandrov and K. F. Galkovskaya (Ministry of Health, USSR). Federation Proc., Transl. Suppl., Pt. II, 23: T59-61(Jan.-Feb. 1964).

Investigations were made on the incidence of neoplasms in mice under various conditions of whole-body irradiation, and special attention was given to the problem of how the dose rate affects the blastomogenic action of radiation. Female mice were irradiated with Co gamma rays in a dose of 800 r at a rate of 23 r/min or 87 or 3.7 mr/min. Thus the intensity of irradiation was varied by a factor of more than 6000 (23 r/min-3.7 mr/min). The neoplasms of the hematopoietic systems detected in the animals were represented by leukemia and lymphosarcoma of the thymus. The incidence of lymphosarcomas showed a marked dependence on the dose rate, the medium rate (87 mr/min) being optimal for this type of tumor; with the lower (3.7 mr/min) or higher (23 r/min) dose rate the neoplasms were significantly less frequent. A different pattern was found in the case of leukemia: its incidence increased at first, but was maximal at the medium dose rate (87 mr/min), and showed no further increase with higher dose rates. (P.C.H.)

9855 REACTION OF THE ADRENAL GLANDS OF HYPOPHYSECTOMIZED RATS TO UNILATERAL ADRENALECTOMY, ADMINISTRATION OF EPINEPHRINE, AND IRRADIATION. E. R. Bagramyan (All-Union Inst. of Experimental Endocrinology, USSR). Federation Proc., Transl. Suppl., 23: Pt. II, T189-93(Jan.-Feb. 1964).

An investigation was made to determine whether the adrenal ascorbic acid reaction to external x irradiation, unilateral adrenalectomy, and epinephrine administration is restored at late periods after hypophysectomy. External x irradiation of rats at late periods after hypophysectomy was not accompanied by a decrease in ascorbic acid content of the adrenal glands. Compensatory hypertropy in response to unilateral adrenalectomy does not develop in hypophysectomized rats, regardless of the period after removal of the pituitary body. A significant decrease in the ascorbic acid content of the adrenal glands was observed in normal rats after epinephrine administration. Administration of epinephrine to rats 24 hr and 25 days after hypophysectomy did not change the adrenal ascorbic acid content. The data obtained indicate that no compensation for the adrenocorticotropic function of the hypophysis or extrahypophyseal pathways of action on the adrenal gland have developed at late periods after hypophysectomy. The results also confirmed that the effect of different stimuli on adrenal ascorbic acid takes place through the adenohypophysis. (P.C.H.)

9856 THE RADIOSENSITIVITY OF DROSOPHILA SPERMATOGONIA. I. ACUTE DOSES. Per Oftedal (Norsk Hydro's Inst. for Cancer Research, Montebello, Norway). Genetics, 49: 181-93(Feb. 1964).

The frequency of sex-linked recessive lethals in Drosophila melanogaster was measured after irradiation of spermatogonia with 0, 55, 110, 160, and 300 r doses of 180 kev x rays. A nonlinear dose-effect relationship was found, with maximum effect of 0.14% lethals at 160 r, and practically no effect at 300 r. Differential killing in conjunction with sensitivity variations is invoked to explain the results. (auth)

9857 PHYSIOLOGICAL GENETICS OF MELANOTIC TUMORS IN DROSOPHILA MELANOGASTER. II. THE GENETIC BASIS OF RESPONSE TO TUMORIGENIC TREATMENTS IN THE tu^K AND tu bw; st su-tu STRAINS. B. Burnet and J. H. Sang (Agricultural Research Council Poultry Research Centre, Edinburgh). Genetics, 49: 223-35(Feb. 1964).

The inbred tu^K and tu bw; st su-tu strains of Drosophila melanogaster have a low incidence of melanotic tumors when cultured on a complete, defined medium under germ free conditions. Suboptimal balances of pentose nucleotides in the larval diet, cholesterol deficiency, an excess of L-tryptophan, and exposing embryos to x irradiation, cause an increase in tumor penetrance in the two strains and their F_1, but there are quantitative differences between them. The response of the tu^K strain to treatment is due to a gene of low penetrance (tu^K) on the second chromosome, and a recessive enhancer modifier ($e\text{-}tu^K$) on chromosome 3. The response of the tu bw; st su-tu strain is also due to a tumor gene (tu bw) on the second chromosome, which in normal environmental conditions is hypostatic to a recessive third chromosome suppressor (su-tu). It is fully penetrant in the absence of environmental treatments in genotypes containing the dominant allele ($+^{su\text{-}tu}$) of the suppressor locus. Dietary-environmental treatments that increase tumor penetrance are thought to influence the reaction controlled by the tumor gene, rather than to interfere with the action of a specific tumor suppressor. (auth)

9858 A LOCUS THAT CONTROLS FILAMENT FORMATION AND SENSITIVITY TO RADIATION IN ESCHERICHIA COLI K-12. P. Howard-Flanders, Eva Simson, and

Lee Theriot (Yale Univ., New Haven). Genetics, 49: 237-46(Feb. 1964).

Long form radiosensitive mutants were selected from among the progeny of survivors of an ultraviolet irradiated parental strain of E. coli K-12 by their mucoid appearance on supplemented minimal agar. The parental strain was F^- and carried various auxotrophic markers. Crosses with Hfr strains revealed that all the long-form cells carried a mutation at a locus designated lon, which is situated between lac and gal, close to T6. The parental lon^+ strain resembles B/r in survival following x or uv irradiation, while lon mutants are relatively sensitive and are similar to strain B. The greater radiosensitivity of the lon mutants is not due to the loss of the capacity to reactivate uv-photoproducts in DNA because equal numbers of plaques are found when uv irradiated T1 phage is plated on lon and lon^+ strains. (auth)

9859 THE EFFECTS OF X RAYS ON INSEMINATION AND SPERM RETENTION IN DROSOPHILA. Armon F. Yanders (Michigan State Univ., East Lansing). Genetics, 49: 309-17(Feb. 1964).

The effect of x rays on insemination success and retention of sperm during storage in inseminated females was studied by direct microscopic estimates of the relative fullness of excised ventral receptacles in female Drosophila melanogaster dissected at intervals following mating. Males were treated at 12 x-ray dose levels ranging from 500 to 75000 r and mated for 24 hours to untreated, virgin females. The insemination success in groups of females dissected immediately after the mating period was significantly lower in treated groups than in the controls at all doses of 4000 r or more. The reduction in insemination was proportional to –0.0066 times the dose in kiloroentgens at doses to 40 kr, and was even more extreme at doses of 60 and 75 kr. Males were treated with 4000, 25000, or 50000 r of x rays and mated for 24 hours to virgin untreated females. The insemination success in females dissected immediately after the mating period was lower in each treated group, and the retention of sperm after 7 and 14 days of storage in the females was drastically reduced in the 25000 and 50000 r groups. Inseminated females were treated at eight x ray dose levels ranging from 5000 r to 50000 r, and dissected at times ranging from 2 hours to 17 days after irradiation. Reductions in the success of the sperm retention were first noted 24 hours after irradiation at the highest dose levels, and became evident even at lower doses within the 17-day storage period. It was concluded that some aspect of sperm behavior, possibly motility, is affected by x rays at doses within the range commonly employed in genetic studies. This finding is significant for the analysis of induced mutation rates in Drosophila. (auth)

9860 X-RAY INDUCED MUTATIONS IN SPERMATOGONIAL CELLS OF DROSOPHILA AND THEIR DOSE-FREQUENCY RELATIONSHIP. S. Abrahamson and L. D. Friedman (Univ. of Wiconsin, Madison). Genetics, 49: 357-61(Feb. 1964).

Spermatogonial x-ray induced mutation rates were determined in adult Drosophila males. The mutation frequency was found to be proportional to dose for doses of 3000 to 12000 r. (auth)

9861 THE EFFECT OF ULTRAVIOLET RAYS ON THE DEHYDRASE ACTIVITY OF COLI AND SALMONELLA GROUPS OF BACTERIA. R. K. Lipinska. Gigiena i Sanit., No. 10, 19-23(Oct. 1963). (In Russian)

An investigation showed that the bactericidal action of ultraviolet rays paralleled their effect on the dehydrase activity of Coli and Salmonella groups of bacteria. Consequently, it may be assumed that the dehydrase ferments play an important role in the mechanism of ultraviolet light action and that the inactivation of bacteria is the result of the inhibition of their dehydrase activity. (auth)

9862 EFFECT OF CHLORAMPHENICOL ON GROWTH AND NUCLEIC ACID SYNTHESIS IN NORMAL AND ULTRAVIOLET CELLS OF VIBRIO CHOLERAE. N. K. Kapoor, P. Sagar, and S. C. Agarwala (Central Drug Research Inst., Lucknow, India). Indian J. Exptl. Biol., 1: 84-7(Apr. 1963).

Chloramphenicol was shown to significantly inhibit DNA synthesis and to some extent RNA synthesis in normal cells of Vibrio cholerae. In the case of ultraviolet-irradiated cells, chloramphenicol almost completely prevents the recovery of DNA synthesis from the effects of irradiation and inhibits RNA synthesis almost to the same extent as in the normal cells. The incorporation of C^{14}-adenine, specifically taken up by the nucleic acids, is also inhibited by chloramphenicol in both normal and irradiated cells. However, chloramphenicol prevents the abrupt decline of optical density in the case of irradiated cultures during the later stages of growth, presumably due to lysis. (auth)

9863 MUTATIONAL SYNERGISM BETWEEN RADIATIONS AND METHYLATED PURINES IN ESCHERICHIA COLI. Ira N. Doneson and Delbert M. Shankel (Univ. of Kansas, Lawrence). J. Bacteriol., 87: 61-7(Jan. 1964).

A synergistic mutational effect was demonstrated between low doses of ultraviolet light and the methylated purines caffeine, theophylline, and theobromine. Caffeine produced the greatest effect and theobromine the least effect. The magnitude of the synergism was inversely related to the ultraviolet dosage. A large percentage of the synergistic effect could be photoprevented by exposure of the ultraviolet-treated cells to white light prior to exposure to the analogues. The consequence of the combined treatment occurred only when the chemical treatment followed the ultraviolet treatment. Furthermore, it was necessary to administer the chemical treatment soon after the ultraviolet treatment or the mutants were lost. When cells were treated with low dosages of ultraviolet light and of x radiation, the result was merely additive, and combinations of x ray and chemical treatment yielded no synergism. Synchronous growth studies indicated that a particular growth stage of the organisms was most susceptible to the synergistic effect. The mutation studied was that of Escherichia coli B/r to high-level streptomycin resistance. (auth)

9864 THE DIFFERENTIAL SENSITIVITY OF FLOUR BEETLES, TRIBOLIUM CONFUSUM AND T. CASTANEUM TO X-RAY ALTERATION OF REPRODUCTIVE ABILITIES, INDUCED DOMINANT LETHALS, BIOMASS, AND SURVIVAL. H. E. Erdman (General Electric Co., Richland, Wash.). J. Exptl. Zool., 153: 141-7(July 1963).

Some aspects of growth are reported for x-rayed populations of wild-type flour beetles cultured as single- or mixed-species. Irradiation with 250-kv x rays was carried out at 1 kr/min to total doses of 2, 4, or 6 kr. Reproductive abilities, measured as the mean number of F_1 adults per female, for single-species populations of T. castaneum given 2 hr approached control values after one month, whereas those of T. confusum persisted below controls. Four kr was almost sterilizing, over 90 and 99% sterilizing respectively for T. castaneum and T. confusum, while 6-kr doses induced complete sterility in both species. Dominant lethals induced by 2 kr were approximately twice as abundant in T. confusum as in T. castaneum. Increased fertility with time was considered evidence that undifferentiated

gametes were more radioresistant than mature ones. Selective elimination of a flour beetle species (T. confusum) in coexistence was indicated at exposures greater than 4 kr of x rays but less than 6 kr. Interspecies antagonism and 2-kr irradiation, as an environmental stress factor, appeared additive in adversely influencing the reproductive ability of T. confusum. The dose-response curves for reproduction were linear up to 4 kr except for T. confusum. After 4 kr the dose-response curves departed from linearity for both species. Biomass (standard dry wt) of F_1 adults decreased with increasing dose; however, the weight of individuals was not altered. Parental mortality was not affected at 2 and 4 kr; 94 to 100% were alive at 10 weeks. In the 6-kr group, 75 and 58% of T. confusum were alive in the single- and mixed-species populations, respectively, indicating that irradiation and coexistence reduced survival. Thus, these 2 organisms of similar biology differed radiologically, as seen by the overall greater radioresistance of T. castaneum compared with that of T. confusum. The one more pair of chromosomes in T. castaneum probably does not satisfy a genetic interpretation of radioinduced damage, but physiologic and cytogenetic factors may be responsible. (BBB)

9865 A BIOPHYSICAL THEORY FOR RADIATION-INDUCED POLYGENIC MUTATIONS. Sohei Kondo (National Inst. of Genetics, Misima, Japan). J. Genet., 58: 216-24(Mar. 1963).

General equations was derived for estimating polygenic mutation rate per locus per unit dose. An example is presented in order to show how to use the equations for calculating polygenic mutation rate. A crude model is proposed to account for the characteristics of radiation-induced polygenic mutations. (C.H.)

9866 SEX AND RADIATION AS FACTORS IN LEARNING PERFORMANCE BY RHESUS MONKEYS ON A SERIES OF DOT DISCRIMINATION PROBLEMS. A. A. McDowell and W. Lynn Brown (Univ. of Texas, Austin). J. Genet. Psychol., 101: 273-8(1962).

Studies were conducted with 64 rhesus monkeys, aged 36 to 48 months, 56 of which had been exposed to nuclear radiation at the Nevada Test Site approximately 24 months earlier. Total exposure (γ + neutron dose) varied from 273 to 670 rem. The initial learning study involved preliminary Wisconsin General Test Apparatus (WGTA) training. Following this they were tested on reduced-cue discrimination problems and then on delayed-response problems. A series of 5 dot-discrimination problems was presented in order of decreasing size of the dot. Statistical analysis of the error data, using a non-orthogonal analysis of variance design, yielded the following results: errors increased significantly as the diameter of the black dot was decreased; the radiation-by-problems interaction was significant, that is, the higher the relative radiation dosage, the fewer the errors as the diameter of the black dot decreased beyond the third problem; and the sex-by-problems interaction was significant with the increases in errors on 2 of 5 problems tested, being greater for the male than for the female monkeys. It was concluded that the results reflect the increased attentiveness of irradiated monkeys and the greater attentiveness of females over males. They are consonant with previous research findings, involving either the radiation factor or the sex factor in learning performance, which show performance facilitation for both irradiated and female monkeys on tasks that place a premium on attention. (BBB)

9867 THE ORIGIN OF ENDOGENOUS PROTEUS MIRABILIS BACTEREMIA IN IRRADIATED MICE. F. Wensinck (National Defense Research Organization TNO, Rijswijk, Netherlands). J. Pathol. Bacteriol., 81: 395-400(1961).

Studies were conducted on mice which were normal carriers of Proteus mirabilis and died with Proteus bacteremia after irradiation. The distribution of P. mirabilis in male C57B1 mice was studied in an attempt to correlate the presence of Proteus in the respiratory or intestinal tract with the occurrence of Proteus bacteremia after irradiation. Nasal swabs, nasopharyngeal swabs, and fresh feces were repeatedly cultured during a period of several weeks preceding x irradiation with a LD_{100} of 700 r. The animals were classified as permanent carriers, temporary carriers, intermittent carriers, and noncarriers. The permanent carriers commonly died with Proteus bacteremia after irradiation; this type of bacteremia was rarely encountered in the noncarriers. The findings showed that Proteus bacteremia was positively correlated with the presence of Proteus in cultures of the nasopharynx. It concluded that the portal of entry for this type of bacteremia is located in the respiratory tract and not in the intestinal tract. Edema of the snout in irradiated mice was almost characteristic of Proteus infection and may be due to involvement of the nasal cavity. Proteus bacteremia has repeatedly been mentioned in support of the hypothesis of the enteric origin of irradiation bacteremia. The present findings, however, show that it is wrong to assume that the organism must originate from the intestine. (BBB)

9868 THE ORIGIN OF INDUCED PSEUDOMONAS AERUGINOSA BACTEREMIA IN IRRADIATED MICE. F. Wensinck (National Defense Research Organization, TNO, Rijswijk, Netherlands). J. Pathol. Bacteriol., 81: 401-8(1961).

Experiments were conducted in 2 strains of mice lethally irradiated with whole-body doses of 200-kv x rays and subsequently inoculated with an organism considered to be a normal inhabitant of the mouse. The LD_{100} doses for the C57B1 and CBA mice used were found to be 700 and 675 r, respectively; all animals were exposed to 700 r. A bacterial culture (P. aeruginosa) was introduced into the respiratory or intestinal tract of mice after irradiation. Nasal inoculation on the 3rd, 4th, or 5th day after irradiation always led to bacteremia, and the mean survival time after inoculation varied between 2 and $2\frac{1}{2}$ days. Gastric instillation of the organisms gave bacteremia in about 60% of animals. The frequency of Pseudomonas bacteremia following nasal inoculation on the 2nd day after irradiation was correlated with the presence of the organism in the respiratory tract and was independent of its presence in the intestine. Cervical lymph glands, liver, and spleen were infected in the prebacteremic stage. After gastric instillation, accidental infection of the larynx occurred in 60% of the animals. It is concluded that Pseudomonas bacteremia originates from the respiratory tract whether the organism is inoculated via the respiratory tract or via the stomach. Local damage to the respiratory mucosa, invasiveness of the inoculated strain, and impairment of cellular defense appeared to be the principal factors leading to bacteremia. The fact that the cervical lymph glands were involved, and not the mesenteric glands, indicates that the portal of entry is located in the respiratory mucosa and not in the intestinal tract. The occurrence of Pseudomonas bacteremia in about 60% of mice inoculated by gastric instillation can be explained by the frequent infection of the larynx resulting from this procedure. (BBB)

9869 REGENERATION OF PERIPHERAL-NERVE DEFECTS BY IRRADIATED HOMOGRAFTS. Leonard

Marmor (Univ. of California, Los Angeles). Lancet, 1: 1191-2(June 1, 1963).

A new method, employing ionizing radiation, is described for preparing peripheral nerves for homografting procedures. Nerve grafts were removed and immediately placed in polyethylene tubing, stored at −12°F, and later irradiated with 2,000,000 rep high-energy electrons for 10 sec at the temperature of dry ice with a Van de Graaff generator. Wistar and Long-Evans rats were used as donors and recipients to test the irradiated nerves. In each recipient rat an irradiated nerve and a nerve treated in a similar manner but without irradiation were implanted subcutaneously into separate legs. The nonirradiated grafts provoked a strong inflammatory response, and those which had been irradiated provoked little or no such response. Also, 3- to 4-cm defects were created in the proximal portion of the peroneal nerves of mongrel dogs, and irradiated nerve grafts prepared in the same manner were sutured into place. Within six months, return of function was seen in all the dogs. Because the results in these animal experiments were so uniformly successful, clinical use of the same technique was planned. Irradiated human nerve grafts were prepared from the tibial nerve of an amputated leg, and the successful results in the first two patients are reported. A 3-in. homograft was inserted in the median nerve at the wrist of a patient who had lost a segment of nerve a year previously. Four months after the grafting of irradiated nerve the patient had return of sensation in the thumb and 4 fingers. Clinical repair was also attempted in a 19-yr-old boy who had lost 5 in. of his ulnar nerve from a gunshot injury, with complete loss of function. A $5\frac{1}{2}$-in. irradiated tibial graft was inserted into this large defect and 5 months later he had a return of sensation in the palm and fourth finger. (BBB)

9870 FAILURE OF X-RAY IRRADIATION TO INHIBIT RIBONUCLEIC ACID POLYMERASE ACTIVITY IN REGENERATING RAT LIVER NUCLEI. P. Chambon, P. Mandel, J. D. Weill, and S. Busch (Institut de Chimie Biologique, Faculte de Medecine, Strasbourg). Life Sciences, No. 5, 167-71(1962).

In regenerating rat liver, inhibition of DNA synthesis following whole-body irradiation during the so-called postmitotic presynthetic period G1, is accompanied by a significant decrease of thymidylate kinase and DNA polymerase activities. RNA polymerase activity also increases in rat liver nuclei after partial hepatectomy, and this RNA may be messenger RNA for protein-synthesizing systems. The effects of x irradiation on this RNA polymerase activity 2, 4, 6, and 12 hr after partial hepatectomy, i.e., during the G1 period, were investigated. The hepatectomized rats received 750 or 1500 r of whole-body x irradiation 2 and 12 hr later and were killed 12 or 18 hr after hepatectomy, since RNA polymerase activity starts to increase 9 hr after the operation, reaches a maximum between 12 and 18 hr, and decreases significantly after 24 hr. RNA polymerase activity in nonhepatectomized control rat liver rose from 196 $\mu\mu$moles/mg to levels 12 and 18 hr after partial hepatectomy of 452 and 442 $\mu\mu$moles/mg, respectively. Results in irradiated rats show that the mechanism which enhances the RNA polymerase activity in regenerating livers is not radiosensitive at doses up to 1500 r, since the pattern of increase is not altered when x rays are administered up to 9 hr after hepatectomy. The enzyme itself is not radiosensitive up to the same dose, since x-ray exposure 12 hr after hepatectomy, when enzymatic activity reaches a maximum, did not lead to any decrease 6 hr later (i.e., 18 hr after operation). Thus the increase in RNA polymerase activity after hepatectomy is unaffected by x irradiation. These data suggest several hypotheses, which are discussed, to explain how irradiation, through alteration of nuclear RNA metabolism, affects the formation of enzymes required for DNA synthesis in regenerating rat liver such as thymidylate kinase and DNA polymerase. Although RNA polymerase activity is unaffected by irradiation, the previously reported disturbance of the metabolism of nuclear RNA after x-ray exposure could be explained by a decrease in nuclear phosphorylations. There is probably a disturbance in the biosynthesis of the nucleolar RNA, which plays a part in protein synthesis. Moreover, in the case of high doses of x rays (1500 r), DNA may be damaged, resulting in the formation of nonsense RNA, since RNA polymerase can use nonspecific DNA as template. The disturbance in protein synthesis induced by x rays can be ascribed also to a change in cytoplasmic metabolism; thus a decrease of mitochondrial oxidative phosphorylations, such as described in the liver after irradiation, can also account for inhibition of synthesis of enzymes required for the biosynthesis of DNA, without implying any disturbance in the metabolism of nuclear RNA's. It is suggested that several of these mechanisms are involved. (BBB)

9871 THE EFFECT OF ELECTROMAGNETIC RADIATION ON TISSUE. Carl F. Tessmer (Walter Reed Army Medical Center, Washington, D. C.). Military Med., 128: 334-44(Apr. 1963).

Cytologic and histologic effects of ionizing radiations are reviewed. Topics discussed include alteration of the mitotic pattern, giant cell formation, endothelial response, alteration of elastic tissue, relative tissue radiation sensitivity, pigment response, physical factors, and time-dose factors. Classic examples of chromosome abnormalities in the active mitotic stages are described and illustrated. The liver of rats receiving 1000 rad showed little morphologic change. Partial hepatectomy produced accelerated growth, but without the high numbers of aberrant mitoses; combined irradiation and hepatectomy demonstrated radiation effects otherwise not apparent. In studies of the relation between radiation mitotic suppression and giant cell formation, within a certain range (50 to 1000 rad) an inverse relation was shown to exist between radiation and cell division. Cells showed increasing size and irregularity as they failed to undergo mitotic division. These larger cells constituted an increasing percentage of the tissue culture cells with increased radiation. Giant cell formation also occurs in tumor tissue following the absorption of ionizing radiation; in tissue culture of tumor strains, cells were observed 200 times as large as controls following irradiation. Their increase in volume and mass was exponential, ceasing at 12 days. The endothelial response to internal radiation from Thorotrast is discussed. The effect is described of doses of 2-Mev electrons of 4000 rad at the basal layer in pig skin, resulting in the destruction of pigment-forming cells. A theoretical representation is presented of the ionizing and absorption events resulting from exposure to 1-Mev β particles. The number of events of a given energy within the β spectrum and the depth to which these particles may penetrate in tissue or equivalent density material are discussed. It was shown that a fixed depth cannot be represented for the skin structures, particularly the hair follicles. It is suggested that biologic systems respond to total dose rather than dose rates; i.e., in general, a large dose in a short time has the same effect as a small dose over a long time. Cytologic changes in reticuloendothelial cells subjected to high doses of radiation are described. In the

splenic follicles of animals exposed to 9000 rad and above there is evidence of nuclear damage, extensive cytologic reaction, and failure of phagocytic activity, as indicated by cellular debris present on the sixth day, justifying the term irreversible damage. Morphologic changes indicative of cell death have been noted with uniformity in the reticuloendothelial tissues at levels of 9000-rad total-body irradiation and above as a single dose. This finding of a breaking point points to the ultimate limits of supportive and replacement therapy. (BBB)

9872 EFFECTS OF X-RAYS ON NUCLEAR RNA OF LYMPHATIC CELLS. Kazuhiro J. Mori and Toshiteru Morita (Kyoto Univ.). Nature, 200: 1323-4(Dec. 28, 1963).

Studies were made on the effects of x radiation on nuclear RNA of lymphatic cells in rabbit appendix. Seven groups of RNA fractions were separated by chromatography: F-I (fraction I) eluted by phosphate buffer; F-II by sodium chloride at 0.1 M; F-III at 0.15 to 0.2 M; F-IV at 0.5 M; F-V at 0.6 M; F-VI at 1.0 M; F-VII eluted by 0.5 N NaOH. Irradiation with 1000 r caused no significant changes in the chromatographic pattern of RNA. By irradiating with 2000 r, F-IV and V decreased slightly, while F-I and -II increased as compared with those of normal. After 10 000 r irradiation, F-IV and -V decreased remarkably, and F-I was much more increased than that at the 2000 r dose. Incorporation of P^{32} into the fractions of RNA was also influenced by x irradiation. The results demonstrate that RNA is reduced both in amounts and in the degree of incorporation of P^{32} by x irradiation, and that the RNA incorporating P^{32} at a low rate is more sensitive to x rays than that incorporating at a high rate. (P.C.H.)

9873 MECHANISM OF DISTURBANCES OF PROTEIN AUTOLYSIS IN THE LIVER OF IRRADIATED RATS. Yu. E. Kudryashov, B. A. Tomsadze, and Hao-tu Liu. Nauchn. Dokl. Vysshei Shkoly, Biol. Nauki, No. 1, 96-9(1963).

Male rats were irradiated once (200 roentgens) using a cobalt source. The autolysis rate was determined in the liver, removed and hemolyzed in a fourfold volume of cold water, and also in homogenate of liver irradiated by various doses at a dose strength of 500 roentgens. An increase in the autolysis rate was observed upon irradiation of liver in vitro proportional to the increased autolysis temperature (+5, +17, and +37°), although the autolysis rate did not depend on high irradiation doses (600-500 kiloroentgens). Upon irradiation of the rats the autolysis rate increased in irradiated rats compared to unirradiated. It was proposed that disturbance of autolysis in the liver of rats irradiated by relatively low radiation doses is associated with the appearance of toxic substances of the oxidized oleic acid type. (Referativnyy Zhurnal, Biologicheskaya Khimiya, No. 17, Sept. 1963)

9874 CHANGE IN ELECTRICAL RESISTANCE OF ERYTHROCYTES UNDER THE EFFECT OF GAMMA RAYS. Yu. A. Kriger and A. A. Vaynson (Moscow State Univ.). Nauchn. Dokl. Vysshey Shkoly, Biol. Nauki, No. 4, 80-3 (1963).

Ohmic resistance of human erythrocytes in suspension to both low- and high-frequency current was found to increase after gamma irradiation; the onset and intensity of increase were directly proportional to the dose of irradiation. Increased resistance to low-frequency current was attributed to swelling of the RBC stroma that had lost hemoglobin but which otherwise remained intact. Resistance to high-frequency was unexpectedly found to be accompanied by loss of potassium ions, invalidating a starting hypothesis; an alternative explanation offered involves lipoprotein complex decomposition products. (OTS)

9875 THE NEUROHYPOPHYSIS IN POSTIRRADIATION POLYURIA: V. Holecek, J. Petrasek, V. Schreiber, Z. Dienstbier, and V. Kmentova (Charles Univ., Prague). Physiol. Bohemoslov., 11: 119-22(1962).

Large doses of whole-body irradiation with x rays are followed by a temporary increase in the urine flow; maximum values are reached during the first 24 hours and may attain as much as five fold the initial value. Urine flow, K, Na, and Cl excretion and the concentration of antidiuretic hormone in the neurohypophysis were studied in male Wistar rats exposed to 600-r, whole-body doses of x rays. Irradiation resulted in polyuria, with an almost 2-fold rise in urine volume, accompanied by increased urinary excretion of Na, K, and Cl. The only pronounced change observed, the increase in the antidiuretic hormone concentration in the hypothalamus on the fourth day after irradiation, was evidently a manifestation of starvation rather than a consequence of irradiation. It is concluded that osmotic effects predominate in the causation of polyuria following irradiation. For clinical applications it is recommended that postirradiation polyuria in man should be treated in accordance with the results of tests of osmotic relations in the blood and that there are no grounds for antidiuretic hormone therapy to correct renal impairment. (BBB)

9876 ACUTE MYELOSIS IN A PATIENT WITH HYPERTHYREOSIS TREATED BY IONIZING RADIATION. Maciej Gembicki and Witold Kras'nik (2nd Clinic of Internal Diseases, Academy of Medicine, Poznan, Poland). Polski Tygod. Lekar., 18: 1815-17(Nov. 1963).

The treatment of acute myelosis in a hyperthyreotic female patient by ionizing radiation is reported. The patient had been treated with x rays for hyperthyreosis, then sterilized by irradiation because of changes in the ovaries. As a relapse of hyperthyreosis became apparent, methylthioraucyl was administered. However, a harmful reaction to the drug was noted and when circulatory failure occurred, treatment with radioactive iodine was given. The possibility of circulation of the irradiations and their effect on the appearance of myelosis are discussed, along with the approximate doses of irradiation on the patient's body during the treatment with radioactive iodine I^{131}. (OTS)

9877 PHOTOREVERSIBILITY OF INDUCED MUTATIONS IN A NONPHOTOREACTIVABLE STRAIN OF ESCHERICHIA COLI. Evelyn M. Witkin, Nicholas A. Sicurella, and Grant M. Bennett (New York State Univ., Brooklyn). Proc. Natl. Acad. Sci. U. S., 50: 1055-9 (Dec. 1963).

A radiation-resistant derivative (strain H/r) of a nonphotoreactivable mutant strain of Escherichia coli was found to be incapable of photoreversing uv-induced mutations to streptomycin resistance, as well as uv killing. Photoreversibility of uv-induced mutations to prototrophy, however, was found to be essentially normal in an arginine-requiring substrain of H/r (H/r30). It was concluded that photoreversal of uv-induced mutations to prototrophy does not require the photoreactivating enzyme. (auth)

9878 ANALYSIS OF ULTRAVIOLET LIGHT-INDUCED MUTAGENESIS BY DNA TRANSFORMATION IN BACILLUS SUBTILIS. Roy A. Jensen and Felix L. Haas (Univ. of Texas, Houston). Proc. Natl. Acad. Sci. U. S., 50: 1109-16(Dec. 1963).

Results are reported from an analysis of ultraviolet-induced mutations of Bacillus subtilis. The analysis was restricted to changes localized in the desoxyribonucleic acid. (C.H.)

9879 EFFECT OF X IRRADIATION ON THE PRIMING ACTIVITY OF DNA. Helen Harrington (Western Reserve Univ., Cleveland). Proc. Natl. Acad. Sci. U. S., 51: 59-66(Jan. 1964).

The activity of DNA as a primer for RNA- and DNA-polymerase from E. coli was severely depressed by x irradiation in doses of 1000 r or less. The priming activity for DNA-polymerase appeared to be more readily affected and was reduced in the case of DNA extracted from irradiated lymphoblasts, as well as for DNA irradiated in dilute solution. The optimum concentration of primer in the DNA-polymerase reaction was lower for irradiated DNA than for control DNA, concentrations higher than the optimum being inhibitory in both cases. Mixtures of irradiated and control DNA showed a lower priming activity than that found for the control DNA alone, the extent of the decrease depending on the ratio of the concentration of the control to the irradiated DNA in the mixture, as well as on the amount of enzyme present. (P.C.H.)

9880 THE STUDY OF METABOLIC PROCESSES IN THE THYROID GLANDS OF RATS EXPOSED TO TOTAL ROENTGEN IRRADIATION. M. M. Alikishibekov, M. M. Andreeva, M. D. Abdullaev, and G. V. Teplyakova. Sb. Nauchn. Rabot Nauchn.-Issled. Rentgeno-Radiol. Inst. Azerb. SSR, 216-23(1962).

It was established by experiments on rats that irradiation in doses of 200, 400, and 600 r stimulates the metabolic processes in the thyroid gland; it elevates the absorption of I^{131} by the gland and the inclusion of S^{35}-methionine in the nucleoprotein, the acidic residual proteins of the cell nucleus of the thyroid gland. It expresses clearly the relationship between the metabolic processes studied and the general state of the animals after total irradiation. (Referativnyy Zhurnal, Biologicheskaya Khimiya, No. 18, Sept. 1963)

9881 ON THE PROBLEM OF THE TURNOVER OF RADIOACTIVE IODINE IN THE RAT ORGANISM IN THE PRESENCE OF THE M-1 SARCOMA AND IN TOTAL X-RAY IRRADIATION. REPORT I. M. A. Andre'eva. Sb. Nauchn. Rabot Nauchn.-Issled. Rentgeno-Radiol. Inst. Azerb. SSR, 236-44(1962).

In healthy rats the same quantity of I^{131} enters repeatedly into the thyroid gland. During this process, a definite regularity was observed, graphically represented by lines sloping downward with time together with several maxima. After inoculation of the rats with M-1 sarcoma, the amount of I^{131} dropped sharply, the number of maxima on the accumulation curves fell off, and the intervals between maxima lengthened. Single overall roentgen irradiation with doses of 105 and 210 did not greatly affect the process of I^{131} absorption by the thyroid. Irradiation with a dose of 425 roentgen resulted in an increased I^{131} absorption, but the number of maxima here also remained unchanged. (Referativnyy Zhurnal, Biologicheskaya Khimiya, No. 19, Oct. 1963)

9882 COLLECTION OF SCIENTIFIC WORKS OF THE FACULTY OF MEDICINE, CHARLES UNIVERSITY AT HRADEC KRÁLOVÉ. SYMPOSIUM ON CHANGES IN THE REACTIVITY OF AN IRRADIATED ORGANISM, AT HRADEC KRÁLOVÉ FROM MAY 16TH TO MAY 18TH, 1962. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 1-190(1963).

Thirty-five articles are included; separate abstracts were prepared for 26. Six articles previously abstracted in NSA contain information on: cardiovascular changes during radiation disease; reactivity to vegetative drugs in acute radiation sickness; changes in the activity of the heart after administration of epinephrine in irradiated animals; pressor effects of levarterenol in irradiated rabbits; experimental ventricular tachicardia during radiation sickness; and arterial blood pressure in the course of radiation sickness in dogs. Three brief summaries on changes of the mineral metabolism in radiation disease, changes in vascular regeneration in the wound of irradiated animals, and changes in the blood bed of livers in rats after irradiation were not abstracted in NSA. (P.C.H.)

For abstracts of individual papers see: 9883, 9884, 9885, 9886, 9887, 9888, 9889, 9890, 9891, 9892, 9893, 9894, 9895, 9896, 9897, 9898, 9899, 9900, 9901, 9902, 9903, 9921, 9922, 9923, 9924, and 9925.

9883 INFLUENCE OF PROFESSIONAL EXPOSURE TO IONIZING RADIATION OF THE BLOOD PRESSURE AND THE PULSE (SUMMARY OF THE DISCUSSION CONTRIBUTION). Dušan Kolesár. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 31-3(1963). (In Russian)

Investigations were made on two year's professional influence of ionizing radiation on the blood pressure and pulse of 64 men and 56 women, who were treated clinically in the Clinic of Occupational Diseases in Bratislava first before entering the occupation then in the course of the following two years of work. It was found that the changes of pulse show a tendency of acceleration, meanwhile statistically insignificant, but the total frequency of changes in the blood pressure with regard to the average dispersion from the point of the departing value of the blood pressure is statistically significant already at the end of first year's exposure (p 0.01) even if the structure of the changes in the blood pressure doesn't reach statistical importance at the end of the second year's exposure. (auth)

9884 PRESENT EXPERIENCE WITH THE CHANGES OF REACTIVITY OF THE CSN IN THE COURSE OF ACUTE IRRADIATION DISEASE. Vojtěch Grossmann (Charles Univ., Prague). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 45-55(1963).

A review is presented on the effects of radiation sickness on the central nervous system (CNS). It was concluded that phases after irradiation affect various parts of the CNS in diferent periods and that various parabiotic phases may occur in various portions of the CNS at the same time, so that there is an unusually multiform picture and the principal laws of the changes are very hard to discover. (P.C.H.)

9885 ELECTROSHOCK SEIZURES IN RAT AFTER X-IRRADIATION. Jiří Farský, Stanislav Komenda, Edvard Pospíšil, Bruno Schober, and Jiří Špitálský. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 77-80(1963).

Studies were made on the effects of x radiation on the central nervous system of rats using electroshock seizures as indicators. Whole-body irradiation with doses ranging from 390 to 700 r (in air) shortened the duration of tonic seizures 3 hr after irradiation for at least 3 days. Cysteine in a dose of 800 mg/kg, administered 10 min before irradiation was followed by a statistically significant increase of the duration of tonic seizures whereas in non-irradiated rats it was without effect. It was concluded that electroshock seizures indicate direct damage to the CNS. (P.C.H.)

9886 INFLUENCE OF FATIGUE ON THE HEALING OF FRACTURES ON THE MANDIBLE AFTER IRRADIATION. Vladimir Šícha and Leon Sazama. Sb. Ved. Praci Lekar. Fak. Kralovy Univ. Hradci Kralove, 6: 81-3(1963). (In Russian)

The effect of physical exertion, fracture of the mandible, and irradiation disease on the time of survival was observed in rats. The fatigue caused by swimming of the animals in water had an unfavorable effect on irradiated and injured rats. Its influence was worse if it followed the irradiation than if it preceeded it. Even the degree of fatigue was decisive. (auth)

9887 CHANGES IN THE EFFECT OF THIOPENTAL AND THEIR INFLUENCING IN IRRADIATED ANIMALS. Ctibor Veselý Isidor Šeferna Vojtěch Grossmann (Charles Univ., Prague). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 89-93(1963).

It was found that irradiation of rabbits with 1000 r significantly prolongs the effect of thiopental on the 3rd and 6th days after irradiation. The prolongation is conditioned, in the first place, by irradiation of the head, which is especially marked on the third day following irradiation. The prolongation of ECG changes corresponding to thiopental narcosis after irradiation with 1000 r can be significantly reduced on the third day after irradiation by intravenous administration of 40 mg/kg 2% sodium succinate. (auth)

9888 THE INFLUENCE OF CO_2 ON THE RESPIRATION OF IRRADIATED RABBITS. Miloslav Tušl, Štepánka Švorcová, and Vlastimil Kaut (Charles Univ., Prague). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 95-7(1963).

Studies were made on the influence of 2 and 4% CO_2 on the lung ventilation and the exchange of respiratory gases in rabbits irradiated with a whole-body dose of 900 r, on the 1st, 2nd, 3rd, 6th, and 14th days after irradiation. Progressive decrease in the consumption of oxygen and inability of the organism fully to adapt itself to higher concentrations of CO_2 were found. Although a higher irritability of the respiratory center was observed closely after irradiation, the irritability decreased on the 2nd or 3rd day. (auth)

9889 THE IMPORTANCE OF THE STUDY OF LIVER CHANGES IN RADIATION SYNDROME. Miloslav Skalka (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 107-13(1963).

A review is presented on the post-irradiation effects on the liver in animals. It has been demonstrated that after whole-body irradiation different liver functions are damaged. Not taking into consideration early temporary changes, there are the fine metabolic functions, such as the breaking-down of drugs, oxyreduction, and response to unfavorable conditions. Then there follows a marked damage to chromosecretion and detoxication as well as to the structure and composition of the liver tissue. It was revealed that liver changes are in close correlation with the degree of post-irradiation anemia. The state of the liver's capillary bed also plays a certain role in the changes. (P.C.H.)

9890 MICE LIVER CATALASE ACTIVITY AFTER X-IRRADIATION. Milan Praslička (Safarik Univ., Košice, Czechoslovakia). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 115-18(1963).

The results of studies on the effects of radiation on catalase activity in the livers of mice are reported and discussed. After a dose of 600 r, the catalase activity decreased statistically significantly on the 6th day and later in about 50% of the mice. In animals with a more expressed drop of liver catalase activity later more significant loss of body weight, decrease of erythrocytes count, and fatty degeneration of the liver were observed. In accordance with previous data, the liver catalase activity decreased after starving, in the course of anemia, hypoxia, after administration of amino acids, after castration, adrenalectomia, and riboflavin and vitamin A free diet. It was concluded that liver catalase activity could be a good diagnostic and prognostic indicator of radiation damage. (P.C.H.)

9891 ON THE QUESTION OF LIBERATION OF FERMENTS FROM THE LIVER IN THE COURSE OF IRRADIATION DISEASE. Jaroslav Květina. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 123-6(1963).

After studying the esterolytic activity of the blood and liver simultaneously in rats in the course of acute irradiation disease induced by a dose of 600 r, which corresponds to $LD_{50}/30$ days for rats, it was concluded that the inhibition of liver esterolysis following irradiation is due, in the first place, to the ferment being washed out of the liver and probably also to a simultaneous reduction of its synthesis. (auth)

9892 INFLUENCE OF X-RAY IRRADIATION ON THE FORMATION OF OXIDATION PRODUCTS OF LIPIDS IN LIVER MITOCHONDRIA OF RATS. Karel Lejsek. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 127-30(1963). (In Russian)

The ability of liver mitochondria in rats (isolated in saccharose medium) to create substances reacting with thiobarbituric acid during the incubation at 37 and 4°C (in medium 0.15 M NaCl) was not significantly influenced by the irradiation of rats in vivo with a dose of 600 r the first, third, and sixth day before removal of the organs. During irradiation of isolated mitochondria in vitro by a dose of 10000 r, the amount of oxidation products of lipids measured by the thiobarbituric acid test immediately after irradiation and after 15 minute's incubation at 37°C increased statistically significantly. After 30, 60, 120, 180, and 240 minute's incubation the average amount of thiobarbituric acid chromogens was higher than that in control suspensions, the increase, however, was not statistically significant. (auth)

9893 A CONTRIBUTION TO THE HISTOCHEMISTRY OF THE LIVER OF RATS IN IRRADIATION DISEASE. Milan Pospíšil (Charles Univ., Prague). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 131-3(1963).

A lowering of non-specific esterase and on the other hand a short-timed increase of alkaline phosphatase occur in the liver of rats after whole-body irradiation by a dose of 600 r. The basal energetic substance, glycogen, disappears very soon after irradiation. Changes in the evidence of proteins and fats were not observed. (auth)

9894 THE EFFECT OF SODIUM SUCCINATE ON DEHYDROGENATION ACTIVITY OF THE LIVER TISSUE IN RATS AFTER IRRADIATION. Jaroslav Květina (Charles Univ., Prague). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 137-9(1963).

The activity of liver succinodehydrogenase after irradiation was determined using triphenyltetrazolium chloratum (TTC) as hydrogen acceptor. The criterion observed was the intensity of TTC reduction by the liver tissue of rats at various time intervals after irradiation with 600 r, which corresponds to $LD_{50/30}$ days for rats. The results showed that, beginning with the second hour following irradiation, the activity in the liver homogenate is statistically significantly reduced. Immediately after irradiation the activity of liver homogenate irradiated in vitro with 15000 r is inhibited whereas the dose of 600 r does not change the activity of liver homogenate irradiated in vitro. (P.C.H.)

9895 ELECTRONIC MICROSCOPY OF MITOCHONDRIA FROM THE LIVERS OF RATS AFTER X-RAY IRRADIATION. Ilja Gradil, Jaroslav Květina, and Karel Lejsek. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 141-3(1963). (In Russian)

Mitochondria observed in the electronic microscope were those isolated from the livers of non-irradiated rats and those of irradiated rats on the third and sixth day after x irradiation by a dose of 600 r, which is $LD_{50/30}$ days for rats. From the observations it was concluded that detectable changes occur in the morphologic picture after irradiation that do not exclude the possibility of an intervention concerning the enzymatic activity of liver mitochondria. (auth)

9896 RADIOBIOLOGY OF THE CELL BARRIERS. Bohumil Hluchovský. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 147-54(1963). (In Russian)

Studies on cell barriers showed that changes in permeability set in immediately after irradiation, consequently without any latency. The changes persist for a very long time, even for weeks, in plants. In electrolytes the changes in permeability are in the direction of facilitation, in non-electrolytes in the sense of making the permeability more difficult. (P.C.H.)

9897 EFFECT OF WHOLE-BODY IRRADIATION WITH Co^{60} ON THE KIDNEY FUNCTION. Karel Záruba (Charles Univ., Prague). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 155-9(1963).

Renal function was examined in dogs before irradiation and in radiation sickness induced by a single whole-body irradiation with radioactive cobalt. No serious disorder of the renal function that could induce renal insufficiency was observed in acute radiation sickness or even in the course of fatal radiation sickness. An observed decrease in tubular maximum for paraaminohippuric acid (PAH), Tm_{PAH}, is suggestive of a certain decrease in the function of the tubuli. Changes in glomerular filtration, renal plasma flow, and filtration fraction are believed to be due to changes in renal hemodynamics following irradiation. (P.C.H.)

9898 SOME CYTOLOGIC CHANGES AFTER IRRADIATION IN TUMOUR CELLS. Vladimir Puza and Karel Lejsek (Charles Univ., Prague). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 161-4(1963).

Studies were made on the proportion of pathological and nonpathological mitoses in non-irradiated and irradiated cultures of HeLa cells. The percentate of all mitoses was 7,108 in non-irradiated cells and 4068 in the irradiated group. Another disturbance provoked by x irradiation was the formation of so-called anaphase bridges. The bridges develop when the individual pair chromosomes in anaphase do not separate completely owing to causes vested in the chromosomes themselves. Another disturbance was the creation of multipolar spindles, caused by the multiplication of the centriole. The number of centrioles increases also by the action on dividing cells of another agents. (P.C.H.)

9899 LONG LASTING CHANGES IN CELL PERMEABILITY INDUCED BY X-RAY IRRADIATION. Vladimír Srb, Bohumil Hluchovský. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 165-70(1963). (In Russian)

Using the plasmolytic method, it was confirmed that the permeability of plasmatic cell membranes is considerably damaged by ionizing x radiation (1,000 ± 40 r) on the inner epidermis of the third coat of the onion (Allium sepa L., Vsetaty seedling responding to electrolytic 0.5 M KNO_3) and non-electrolytic (1 M saccharose) plasmolyzing agents in a different manner. It was found further that the mentioned radiation changes in the cell permeability varied during 42 experimental days. On the basis of the course of the changes in the permeability, it is maintained that the changes in the permeability, caused by ionizing x radiation, are of a lasting character and sometimes may even be irreversible. (P.C.H.)

9900 CHANGES IN THE DISTRIBUTION OF INORGANIC S-35 IN IRRADIATED ANIMALS. Vladimir Chmelař, Vojtěch Grossmann, and Milena Hodáňová. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 171-3(1963). (In Russian)

By means of autoradiography, the distribution of inorganic sulfur in the liver, kidneys, and blood in irradiated and non-irradiated mice was observed. In irradiated mice the elimination of S^{35} was faster than in non-irradiated mice. (auth)

9901 CHANGES IN pH OF BODY FLUIDS IN ANIMALS AFTER IRRADIATION. Jaroslav Květina, Bohuslav Zicha, and Hana Dynatatová (Charles Univ., Prague). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 175-7 (1963).

Studies were made on the pH of blood, cerebrospinal fluid, and urine in rabbits and pH of urine in rats in the course of postirradiation disease. The results showed that the actual reaction of the cerebrospinal fluid in rabbits after irradiation show a statistically insignificant tendency to an increase. The tendency is somewhat more marked than the parallel shift of pH of blood toward alkaline values. The pH of urine in rabbits did not change on the 3rd day after irradiation; on the 6th day after it was more acid. (P.C.H.)

9902 A CONTRIBUTION TO THE HISTOCHEMISTRY OF THE KIDNEYS IN IRRADIATION DISEASE. Milan Pospíšil and Karel Záruba (Charles Univ., Prague). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 179-80(1963).

The kidneys of dogs that died after whole-body irradiation with a dose of 600 r of Co^{60} gamma were examined histochemically for evidence of basal enzymes, glycides, and proteins. Striking changes were found in alkaline phosphatase, non-specific esterase, and acid mucopolysaccharides. (P.C.H.)

9903 BACTERIOLOGICAL FINDINGS IN SLAUGHTERED SWINES IRRADIATED BY LETHAL DOSES OF IONIZING RADIATION. Otto Pawel and Vilma Kalousová. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 181-2(1963). (In Russian)

The frequency of bacteriological findings in slaughtered swines, irradiated by 700 and 450 r of gamma radiation Co^{60} was investigated. Animals were slaughtered before the arrival of clinical symptoms of radiation sickness. The organs, lymph nodes, and muscles were investigated. The frequency of positive bacteriological findings was greater in irradiated animals than in nonirradiated controls. (auth)

9904 MULTIPLE MYELOMA WITH A LARGE EXTRAMEDULLARY PLASMACYTOMA OF THE THORAX TREATED WITH PREDNISONE AND RADIATION: METABOLIC BALANCE STUDY DEMONSTRATING UNUSUAL BENEFICIAL SYSTEMIC EFFECTS OF RADIATION ABLATION OF THE PLASMACYTOMA. William A. Skoog and William S. Adams (Univ. of California, Los Angeles). Stanford Med. Bull., 20: 87-101(Aug. 1962).

Effects of irradiation on metabolic factors are described

in a case that is cited as providing an unusual opportunity to compare the effects of prednisone alone and prednisone in conjunction with x-ray therapy on an extraskeletal thoracic plasmacytoma, as well as the myelomatous process in general. Prednisone treatment alone did not depress growth of the large expanding tumor, so supplementary treatment was given under metabolically controlled conditions. Radiation therapy (total dose, 1965 r of 250-kv x rays) caused some reduction in the size of the thoracic plasmacytoma, first noted three weeks after the first x-ray treatment. During the initial 10 days, while the patient received prednisone alone, he was in moderately negative nitrogen balance, averaging −3.46 g/24 hr. Phosphorus balance averaged −0.663 g/24 hr. Coincident with radiation therapy, there was an increase in nitrogen negativity that persisted for ~7 days, but was less marked following completion of radiation therapy. Urinary uric acid excretion increased slightly with the addition of x-ray therapy, but this effect was delayed until near the end of the course of radiation. Serum uric acid levels fell, reaching their lowest levels while the urinary excretion of uric acid was the greatest. To explain these findings, increased tissue destruction coincident with radiation and/or an alteration in the renal regulatory mechanism of uric acid excretion are proposed. Urinary proteins were excreted in small but relatively constant amounts with prednisone alone, but proteinuria gradually disappeared with addition of radiation. This disappearance was coincident with a fall in the abnormally elevated plasma globulin levels. The marked fall in globulins coincident with radiation therapy may be a reflection of diminished production of abnormal globulins because of destruction of plasma cell tumor tissue. With prednisone alone potassium balance average −19.4 meq/24 hr; when radiation was added, potassium balance averaged −24.8 meq/24 hr. Sodium balance was slightly positive during the control period and essentially in equilibrium during the first radiation treatment period. As radiation was continued, however, sodium balance became progressively more negative, reaching a maximum of −28.8 meq/24 hr. Chloride balance mirrored sodium balance except that it was more negative throughout the study. Negative calcium balance persisted throughout the study, but it became markedly less with the addition of radiation to prednisone therapy. It is suggested that the decrease in the hypercalcemia and the negative calcium balance was directly related to the x-ray therapy delivered to the extramedullary plasmacytoma of the thorax. The concept that certain malignant tumors may be capable of producing a parathyroid-hormone-like substance is discussed. Suggestive evidence indicates that the plasmacytoma secreted a parathyroid-like hormone. (BBB)

9905 THE APPEARANCE OF TUMORS IN THE BONE MARROW FOLLOWING TREATMENT OF MYELOLEUCOSIS WITH RADIOACTIVE PHOSPHORUS. V. A. Nechitaylo. Tr. Leningr. Nauchno. Obshchestva Patologoanatomov, 3: 102-4(1962).

A patient, 33, had received in 1954 the first (5.5 microcuries) and 6 months later the second course (5 microcuries) of P^{32} for treatment of chronic myeloleucosis. An incomplete hematologic remission had ensued. Five months after termination of the treatment there appeared in the bone marrow of the bodies of the 10th, 11th, and 12th thoracic and 2nd lumbar vertebrae nodes a tumor of the reticulosarcoma type. It is believed that P^{32} stimulates the formation of tumors. (Referativnyy Zhurnal, Onkologiya, No. 14, July 1963)

9906 RADIATION EFFECTS ON FEMALE GONADS. V. Ya. Karmysheva. Usp. Sovrem. Biol., 56: 117-35 (July-Aug. 1963). (In Russian)

Radiosensitivity of female gonads to whole-body and local pelvic exposure to various doses of radiation was reviewed. Morphological changes of nerve fibers and nerve ends in the ovarian apparatus, disturbances in oestrus cycle and hormonic functions, damage to ovaries, changes in the oviduct, uterus, and vagina and factors influencing the extent of injury are analyzed. Ovogenesis and fertility in irradiated organisms, disturbances in embryogenesis and functional restoration of damaged apparatus are also considered. (R.V.J.)

9907 ON THE ORDER OF INCLUSION OF VARIOUS ORGANS INTO IMMUNOGENESIS IN ACUTE RADIATION SICKNESS. M. I. Ravich-Scherbo and L. G. Prokopenko. Zh. Mikrobiol., Epidemiol. i Immunobiol., No. 10, 5-12 (Oct. 1963). (In Russian)

The order of inclusion of various organs into immunogenesis is the same in healthy and irradiated animals. Following the first injection of corpuscular and soluble antigens antibody formation took place only in the regional lymph nodes. Repeated stimulation with corpuscular antigen caused generalization of immunological response; following double immunization with the soluble antigen immunogenesis was still limited to the regional lymphoid apparatus. Soluble antigen sorbed on homologous erythrocytes proved to be immunologically more effective for the irradiated organism than the crude antigen. (auth)

9908 SEARCH FOR METHODS OF STIMULATING LEPTOSPIROSIS IMMUNITY IN IRRADIATED ANIMALS. V. P. Morozova (Voronezh Medical Inst., USSR). Zh. Mikrobiol., Epidemiol. i Immunobiol., No. 10, 75-80(Oct. 1963).

Research devoted to finding a method of intensifying immunity in animals vaccinated with sorbed leptospirosis vaccine two days after irradiation is discussed. Experiments were conducted on rabbits and speckled susliks (Citellus suslicus Guldenstaedt), which were subjected to massive whole-body irradiation. The animals were divided into groups receiving different combinations of irradiation and inoculation, some having their abdominal organs shielded by a circular screen during irradiation. Large doses of heterogenic serum administered before irradiation considerably increased the rabbits' radioresistance, but completely suppressed antibody production in response to vaccination after irradiation. Small doses of serum administered before irradiation did not increase the animals' radioresistance and failed to stimulate antibody production. The percentage of animals surviving irradiation of the abdominal organs, vaccination with the sorbed vaccine, and infection with a reacting dose of the microorganism was much greater among the animals for which screening was used. (OTS)

9909 THE LYMPHOID TISSUE AS THE SITE OF PRODUCTION OF ANTIBODIES AND THE ALTERATION OF ITS IMMUNOGENIC ACTIVITY UNDER THE INFLUENCE OF IONIZING RADIATION. A. I. Polyak. p.197-200 of "Voprosy Immunopatologii." Moscow, Medgiz, 1963.

Rabbits were immunized subcutaneously with E. coli. A regional lymph node was extracted within 5, 24, or 72 min, or 120 hours and was grafted into the anterior chamber of the eye of an intact rabbit and these were examined histologically and for the presence of live bacteria. The latter were discovered in the lymph nodes within 5 min and within 24 hours. The lymph nodes did not form antibodies

(in the intraocular fluid) in the recipients. On the 3rd and 5th days, antibodies appeared in titers of 1:208 and 1:449. The existence of a preparatory phase of antibody production that flows directly into the body (duration more than 24 hours) within 5 min is presupposed, because a small number of plasma cells, sharply increasing by the first and third day, was found in the lymph nodes. By the 5th day the structure of the lymph nodes was partially restored. Irradiation with 500 r on the 3rd day after the immunization was not reflected in the production of antibodies in the rabbits in whom a lymph node from an irradiated donor was transplanted. When rabbits were immunized on the 10th day after irradiation, no antibodies were formed in the recipients despite the appearance of plasma cells in the transplants. When immunization was done within one month there was noted a feeble formation of antibodies. (Referativnyy Zhurnal, Onkologiya, No. 19, Nov. 1963)

9910 ON THE INVESTIGATION OF THE CHARACTERISTICS OF IMMUNOGENESIS IN RADIATION AFFECTIONS ON A MODEL OF PARATYPHOID INFECTION IN RABBITS. B. M. Kurster. p.200-3 of "Voprosy Immunopatologii." Moscow, Medgiz, 1963.

Rabbits were immunized intravenously three times with a vaccine of the murine typhus pathoden, then irradiated with 500 r and a week later were infected with the same microbe. On the 12th day after the infection the antibody titer had decreased by 52 times in eight animals; a much lesser diminution of titer was noted in the nonirradiated animals. The severity of the disease was also less apparent in the nonirradiated than in the irradiated ones. A leukocytosis increasing after the infection was observed in the immunized animals. Following the radiation it was less noticeable. In the nonimmunized rabbits a leukocytosis appeared within 2-3 days after infection, which had subsequently reverted to a leukopenia. There was noted a sharp distention of blood vessels, hemorrhages, ulcer formation, and even necrosis of the intestines of the irradiated nonimmunized rabbits, but only a moderate plethora and hyperplasia of the lymphoid tissue in the nonirradiated immunized ones. (Referativnyy Zhurnal, Onkologiya, No. 19, Nov. 1963)

9911 RESTORATION OF THE PROTEINS OF HEMOPOIETIC ORGANS IN RADIATION SICKNESS. E. A. Dikovenko and B. V. Blinov. p.31-2 of "Sbornik, Materialy Nauchnoi Konferentsii Instituta Eksperimental'noi Patologii i Terapii, Akademiya Meditsinskikh Nauk SSSR." Sukhumi, 1963.

By intramuscular administration of S^{35}-methionine (I), S^{35}-cystine (II), and P^{32}(Na-phosphate) to rabbits, guinea pigs, and rats 3 hours before irradiation (400-600), an intensive incorporation of (I) and (II) was found in the protein fractions of the hemopoietic organs and a sharp suppression of P^{32} incorporation was found in phosphorus-containing protein fractions. A relatively intense restoration of (I) and (II) was observed in the bone marrow and spleen at a low level of hemopoiesis. It is suggested that restoration of amino acids in the hemopoietic organs of irradiated animals does not reflect the functional condition of the hemopoietic system and, possibly, is not achieved through synthesis of fully valuable protein molecules. (Referativnyy Zhurnal, Biologicheskaya Khimiya, No. 19, Oct. 1963)

9912 EFFECT OF IONIZING RADIATION ON THE DYNAMICS OF RIBONUCLEIC ACIDS IN PLANTS. G. E. Vakarenko. p.376-8 of "Sbornik Fiziologichnoi-Biokhimichnoi Osnovi Pidvishcheniya Produktivnosti Roslin." Kiev, 1963.

The effect of pre-sowing irradiation of the seeds of various cultivated plants on the ribonucleic acid content in the leaves was studied. Seed irradiation employed the gamma rays of Co^{60} in doses of 1000, 5000, 10 000, and 25 000 roentgens, and also made use of P^{32} in a dose of 10 and 150 microcuries/kilogram of seed. Sugar beet, blue lupine, soy, and three melon species were treated. The upper leaflets of 3-day growth were removed for the analysis. It was found that the amount of ribonucleic acid in the leaves of the plants studied changes very sharply under the effect of irradiation. At low irradiation doses (P^{32}, 210 microcuries/kilogram of seed, or gamma rays of Co^{60}, 1000 roentgens) the ribonucleic acid content in the leaves during the budding period was reduced. Irradiation of seeds by high doses promoted a considerable rise in the amount of ribonucleic acid in the leaves. (Referativnyy Zhurnal, Biologicheskaya Khimiya, No. 17, Sept. 1963)

9913 ANTIBAKTERIAL'NYI IMMUNITET I RADIOREZISTENTNOST'. (Antibacterial Immunity and Radioresistance). N. N. Klemparskaya, N. V. Raeva, and V. F. Sosova. Moscow, Medgiz, 1963. 120p.

A review is given of up to date data on antibacterial immunity and radioresistance, and an analysis is made of the prophylactic action of various preparations. Extensive references are included. (R.V.J.)

Radiation Effects Therapy and Countermeasures

9914 (FTD-TT-63-581) INJURIES TO THE SKULL AND BRAIN IN ACUTE RADIATION SICKNESS. N. N. Aleksandrov, S. V. Ryzhkov, L. S. Sukovatykh, I. A. Chalisov, G. B. Chesnokov, E. (Ye.) I. Kiseleva, R. N. Bubnova, and I. G. Ramzen-Evdokimov. Translation from p.1-175 of "Raneniya Cherepa i Golovnogo Mozga pri Ostroy Luchevoy Bolezni" (a publication of the State Publishing House of Medical Literature, Medgiz, 1962, Leningrad). 316p.

Results are summarized from numerous experiments on animals of the clinical course, treatment, and outcome of infected wounds of the skull and brain during radiation sickness. The characteristics of the clinical manifestations and diagnostics of the injuries to the brain and intracranial infectious complications which develop during acute radiation sickness and the results of surgical treatment and the use of various antibiotics are described. These experiments are used as a basis for recommending a broadening of the indications for the use of a primary blind suture. A method is described for using antibiotics which makes it possible to obtain completely satisfactory results in treating infected wounds of the skull and brain during acute radiation sickness, even when there is a considerable delay in the initial surgical treatment of the wound. (850 references.) (C.H.)

9915 RADIOVACCINATION AND SEROTHERAPY TREATMENT OF SKIN RADIATION LESIONS. J. Loiseleur (Institut Pasteur, Paris). Ann. Inst. Pasteur, 104: 811-21 (June 1963). (In French)

Experiments were performed on the skin of rats and rabbits, in which a 2-cm diameter circle of skin was exposed to 3500 r of 50-kv x rays over 155 sec. The radiolesion which developed during a 15-day period presented symptoms of an increasing order of severity: discrete depilation over the whole irradiated area, followed by total depilation, the beginnings of a partial radiation dermatitis, and finally on the 15th day elimination of the whole irradiated area of

skin with exposure of the aponeurosis. At this stage the radiodermatitis was complete, the progression of damage had leveled off, repair had set in and continued slowly for several weeks. If at this stage a second irradiation treatment of the same intensity as the previous one was performed on a different area of skin, a decrease in radiation sensitivity was found, which decreased even further following a third irradiation. Among the factors influencing this decrease were: the initial radiation dose, to which it was directly proportional, and the number of days separating the fractionated irradiations. This phenomenon, which was a general one affecting the whole skin, and a progressive one, each successive irradiation bringing about lesions of lesser consequence, persisted for several weeks. These facts are evidence of a radiovaccination process, products of which were distributed by the blood throughout the whole skin. This radiovaccination assisted only the repair processes without having any preventive action. No initial protection was noted but rather an ever more rapidly appearing process of repair, indicating the presence of a restoration factor. It also was found possible to achieve this radiovaccination effect by injecting serum of radiovaccinated rats into other rats. Treatment was most effective when performed immediately postirradiation. As to the nature of the restoration factor, it is proposed that nucleic acid components, freed at the edge of the lesion, diffuse through adjacent undamaged cells to supply a stimulus for the production of material capable of bringing about repair. The intervention of deoxyribonuclease is necessary in stimulating this repair of radiation necrosis since when deoxyribonuclease is destroyed in radionecrosis lesions, restoration is very late in appearing. To provide additional evidence for the intervention of nucleoproteins in this restoration process, DNA was determined in the wounded skin, serum, and intact skin of rats from which pieces of skin had been cut, during a period of 18 days, while the wounded skin was undergoing healing. DNA content was increased, only returning to normal once scarring was complete. DNA increased in a similar way during radiovaccination and serotherapy, indicating that the same restoration factor may be at work. (BBB)

9916 THE EFFECT OF PYRIDOXINE ON THE RADIOSENSITIVITY AND RECUPERATION OF IRRADIATED YEAST CELLS. M. N. Meisel and L. A. Seliverstova (Inst. of Microbiology, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 153: 194-6(Nov. 1, 1963). (In Russian)

Saccharomyces carlsbergensis 4228 (ATCC) require group B vitamins including pyridoxine for normal development. The yeast cells were cultivated in a sugar-mineral nutrient containing all the necessary vitamins except pyridoxine in order to induce B_6-avitaminosis. A pyridoxine supplement of 0.1 mg/l was fed to the normal cells. The normal and deficient yeast cells were subjected to irradiation with x rays, and the number of colonies observed on a Petri culture served as a test of viability. A 2% suspension of unirradiated cells served as controls. At a dose of 50 kr, the normal cells fed pyridoxine showed a survival of 74% compared to a survival of 40% for the yeast cells deficient in pyridoxine. On increase of the dose to 100 kr, the difference in radioresistance was even greater (45% survival for the normal cells compared to 11% survival for the cells deficient in pyridoxine). The data indicate that the irradiated cells deficient in pyridoxine recover more rapidly than the irradiated normal yeast cells. If a pyridoxine supplement is given to the irradiated cells immediately after irradiation, the number of surviving colonies increases by a factor of 3, as compared to the number of survivals obtained with the yeast cells deficient in pyridoxine and not fed a pyridoxine supplement after the irradiation. (TTT)

9917 THE EFFECT OF INJECTION OF BONE MARROW CELLS ON THE MORPHOLOGICAL DEVELOPMENT OF EXPERIMENTAL INFLUENZA IN IRRADIATED ANIMALS. N. A. Maksimovich and O. P. Lebedeva (Inst. for Infectious Diseases, Kiev). Dokl. Akad. Nauk SSSR, 153: 950-3(Dec. 1, 1963). (In Russian)

Although the administration of bone marrow and spleen to irradiated animals somewhat offsets the effects of the roentgen irradiation, in the presence of an influenza infection in the animals the effect of the marrow and spleen is considered to be less. Therefore, morphological changes were studied in the internal organs, especially lungs, of 320 mice irradiated with 550 r, some of which were subsequently given bone marrow and/or influenza virus. The data showed that transfusion of bone marrow increased the survival of these mice after irradiation in the absence of the virus but not in its presence. Morphological changes in the lung resulting from the influenza infection in the irradiated animals differed from that in usual experimental influenza; they consisted of sharply expressed hemorrhagic components and edema of the lung tissue, with desquamation of the alveolar cells and proliferation and desquamation of the epithelial bronchi and bronchioles. Introduction of bone marrow changed the morphological picture to much nearer that of the unirradiated animal although not increasing the survival. The data obtained confirmed the idea that introduction of bone marrow increases the natural resistance of the animals and stimulates formation of antibodies but at the same time results in a more demonstrable reaction to the influenza antigen, close to the reaction of the nonirradiated animal. (TTT)

9918 THE ABSENCE OF AN OXYGEN EFFECT ON MUTATION AND KILLING INDUCED BY 2537 Å ULTRAVIOLET LIGHT IN OPHIOSTOMA. Goesta Zetterberg (Uppsala Univ.). Hereditas, 48: 409-16(1962).

A uracil-less strain of Ophiostoma multiannulatum was irradiated with uv light. Seven minutes prior to and during the irradiation, oxygen or pure nitrogen was bubbled through the suspension at a rate of 4.5 l/hr. The results make it perfectly clear that the oxygen concentration does not influence the mutagenic and killing effects of 2537 Å uv in Ophiostoma. The results are discussed and compared with other findings. (P.C.H.)

9919 THE DISTRIBUTION BETWEEN CELL NUCLEI OF ISOLOCUS BREAKS AND CHROMATID INTERCHANGES INDUCED BY RADIOMIMETIC CHEMICALS IN VICIA FABA. B. A. Kihlman and Tage Eriksson (Uppsala Univ.). Hereditas, 48: 520-9(1962).

Lateral root-tips of Vicia faba were treated with the radiomimetic agents 8-ethoxycaffeine (EOC), N-methylphenylnitrosamine (MPNA), and N-nitroso-N-methylurethan (NMU). The distribution between nuclei of the induced isolocus breaks and chromatid interchanges was determined and compared with the expected distribution, assuming a Poisson distribution. In all three cases, the distribution of both isolocus breaks and chromatid interchanges did not fit the Poisson distribution, there being an excess of cells containing two or more aberrations and a deficiency of cells having one aberration. The deviation from the expected Poisson distribution was particularly pronounced in the cases of interchanges induced by EOC and MPNA. The results are discussed. (auth)

9920 AUTOLOGOUS HEMAPOIETIC MARROW IN TREATMENT OF ACUTE RADIATION SICKNESS. I. Plesca, V. Muresan, and O. Cavulea. Rev. Sanit. Mil., 58: 786-98(1962).

A study was made to determine the efficiency of autologous medullary transplants, irradiated in vivo and without association with other medications, in combatting irradiation diseases. It was concluded that autologous hemapoietic marrow irradiated in vivo and administered 40-44 hours after irradiation apparently does not offer protection against radiation sickness. After a brief theoretical review of rationale, a summarization of published data, including the 5 Yugoslav nuclear technicians involved in the Vinka accident is presented. 38 dogs were irradiated 550 r in 50 min; 1 hr later, 12 to 20 ml of bone marrow aspirated from their iliac crests, centrifuged 1500 rpm 15 min supernate decanted, 100% of Tyrode sol added; kept at -2°C for 44 hr, rewarmed to 37°C and reinjected i.v. No difference between controls and dogs so treated was found, whereas marrow removed preirradiation did protect 80% in an earlier study. Eight graphs show the course of clinical and hemogram parameters in treated and control animals. (OTS)

9921 ROLE OF THE CENTRAL NERVOUS SYSTEM IN PROCESSES OF RESTITUTION AND COMPENSATION UNDER THE EFFECT OF RADIO-PROTECTIVE AGENTS. S. Ya. Arbusov. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 57-75(1963). (In Russian)

Studies were made on the radiation protective and therapeutic effects of drugs against radiation effects on the central nervous system. Mercamine was found to depress the process of excitation in the cerebral cortex. A certain role in the display of defense responses evoked by mercamine administration was found to belong to the sympathetic nervous system. The preliminary administration of sulfur-containing radioprotective compounds brings about a sedative effect, evolving with time. Imidazole 2-carbonic acid compounds, owing to their sedative effect, prevent any pathological alterations of CNS reactivity. Such a selective effect favors prevention by compensating for radiation injury. The administration of neuroplegic agents (aminazine and phenatine) was found to reduce the extent of impairment and to shorten the time of recovery of a number of unconditioned responses (duration of post-rotatory nystagmus, amount of unconditioned reflex salivation) in treated irradiated animals, as compared to untreated controls. (P.C.H.)

9922 CHANGES IN THE DURATION OF THE CENTRAL INHIBITORY EFFECT OF BARBITAL AND AMOBARBITAL IN IRRADIATED RATS. Milan Dostál. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 85-8(1963). (In Russian)

The narcotic effect of intraperitoneally administered barbital and amobarbital sets is more rapidly in rats on the sixth day following irradiation with 600 r than in non-irradiated control rats. Duration of the narcotic effect on the sixth day after irradiation with 600 r is shortened by barbital and prolonged by amobarbital. X irradiation of rats with a dose of 600 r did not change the fairly uniform distribution of C^{14} barbital administered intraperitoneally in indicator quantity together with a narcotic dose of soluble barbital. Greater activity of the urine recorded 2.5 hours following administration in rats on the third and sixth postirradiation day suggests that a shortened effect of barbital occurs most probably because of its accelerated elimination from the organism. The prolongation of the narcotic effect of amobarbital in irradiated rats may be caused by the postirradiation disorder of the liver because it does not occur after administration of barbital that is eliminated by the kidney without change. (auth)

9923 INFLUENCE OF GLYCEROL-GUAIACOL-ETHER UPON GASTRIC CHANGES AFTER X-RAY THERAPY. Ladislav Brueckner. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 99-100(1963).

Studies were made on the effects of guaiacol-glycerol-ether (GGE) on man after radiotherapy of the stomach. GGE was given intravenously in a quantity of one to four times 10 ml of a 5% solution, in tablets of 0.2 g 3 times daily, or in suppositories. Within 1 to 2 hr after intravenous injection of GGE the picture of post-radiation alterations of the stomach changes. The effect of GGE persisted for 3 to 7 days. The results were favorable in controlling the symptoms of radiation sickness in patients, since marked alleviation and a resulting improvement of the patients psychical state were obtained with the aid of a minimum and inoppressive intervention in the organism. (P.C.H.)

9924 THE EFFECT OF PETHIDINE AND THIOPENTAL ON THE SURVIVAL OF IRRADIATED ANIMALS. Jaroslav Květina and Vojtěch Grossmann. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 101-3(1963). (In Russian)

The study of the effect of pethidine (15 mg/kg) and thiopental (20 mg/kg) on the survival of mice irradiated with 450 and 600 r showed that neither of the drugs worsened the conditions of survival of the animals in the course of induced acute irradiation disease. When pethidine or thiopental was applied immediately before or immediately after irradiation with a dose of 450 r, the death rate of mice decreased to some extent. (auth)

9925 ACTION OF SODIUM DESOXYCHOLATE ON CHOLESECRETION IN IRRADIATED RATS. Josef Šimek. Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 119-22(1963). (In Russian)

In rats irradiated with a dose of 600 r, cholesecretion after application of sodium desoxycholate (5 mg/100 g of body weight) was studied. The basic excretion of bile was usually higher 3 and 6 days after irradiation than in non-irradiated controls. Three and 12 days after irradiation the curve of cholesecretion after application of sodium desoxycholate was similar to the normal one, it was however, shifted to higher values in rats irradiated 3 days earlier. Six days after irradiation following application of sodium desoxycholate a two-phase curve of cholesecretion was recorded. Changes in volume of the excreted bile did not occur in controls and in irradiated rats after iv application of saline (1 ml/100 g of body weight). Excretion of bile after injection of sodium desoxycholate in irradiated rats prepared with saline did not differ from cholesecretion in non-prepared rats. (auth)

9926 SELENOAMINO ACIDS: DECREASE OF RADIATION DAMAGE TO AMINO ACIDS AND PROTEINS. F. Shimazu and A. L. Tappel (Univ. of California, Davis). Science, 143: 369-71(Jan. 24, 1964).

Selenomethionine and selenocystine protect amino acid and protein systems from radiation damage. Selenoamino acids are more powerful protectors than the analogous sulfur amino acids and other known -SH protectors. Free-radical scavenger and repair mechanisms by which selenoamino acids react with induced free radicals may be the key reactions in the biological function of selenium. (auth)

9927 TREATMENT OF RADIATION-INDUCED LESIONS. Semana Med. (Buenos Aires), 121: 1475-6(Oct. 11, 1962). (In Spanish)

A description is given of the symptoms following whole-body exposure of humans to heavy radiation doses. Prognosis and methods of treatment of persons receiving 200- to 600-r doses are discussed. (BBB)

9928 THE EFFECT OF VITAMIN B_1 AND PP ON THE METABOLISM OF CHOLESTEROL AFTER IRRADIATION. E. F. Sopin. Visn. Kiivs'k. Univ., Ser. Biol., No. 4, 114-19(1961).

A study was made of cholesterol metabolism in the liver, muscles, brain, and blood. The experiments were conducted with the assistance of $C^{14}H_3OOH$, which was introduced into guinea pigs two hours previous to the acute testing in the amount of 50,000 imp/min to each g of live animal weight. On the basis of the results it was established that the content of cholesterol following irradiation, compared with the normal, is increased in the liver and blood, decreased in the brain, and practically unchanged in the muscles. The intensity of renovation of cholesterol after irradiation decreases in the liver, muscles, and brain. When Vitamin B_1 and PP is given the irradiated animal, the content of cholesterol increases in all of the organs studied, except in the blood where it diminishes. The intensity of the renovation of cholesterol in the irradiated animal given Vitamin B_1 and PP remains lowered in the liver and muscles, compared with the normal, and it noticeably increases in the brain, approximating the normal. (Referativnyy Zhurnal, Biologicheskaya Khimiya, No. 18, Sept. 1963)

9929 CONDITION OF THE ADRENALS IN RADIATION SICKNESS UNDER CONDITIONS OF CHEMOPROPHYLAXIS. B. V. Blinov. p.12-13 of "Sbornik, Materialy Nauchnoi Konferentsii Instituta Eksperimental'noi Patologii i Terapii Akademiya Meditsinskikh Nauk SSSR." Sukhumi, 1963.

The metabolism of proteins in the nucleoprotein fraction of the adrenals in irradiated guinea pigs previously receiving protective preparations (adrenaline together with acetylcholine), three days after radiation treatment was 76% higher than in the control animals. During subsequent sessions, the intensity of the metabolism was reduced, remaining, however, higher than for animals irradiated without protection. Thus, the prophylactic use of adrenaline together with acetylcholine when the organism is subjected to ionizing radiation intensifies adrenal function, sustaining it at an elevated level during the entire period of radiation sickness. (Referativnyy Zhurnal, Biologicheskaya Khimiya, No. 19, Oct. 1963)

9930 POLAROGRAPHIC INVESTIGATION OF THE OXYGEN TENSION LEVEL IN CEREBRAL TISSUES WHEN THE ORGANISM IS SUBJECTED TO ANTIRADIATION PREPARATIONS. R. B. Strelkov and L. P. Semenov. p.69-70 of "Sbornik, Materialy Nauchnoi Konferentsii Instituta Eksperimental'noi Patologii i Terapii Akademiya Meditsinskikh Nauk SSR." Sukhumi, 1963.

White mice (450) were subcutaneously given, in aqueous solutions, amino compounds (I; adrenaline, serotonin, methoxytryptamine) and sulfur-containing preparations (II; cystamine, β-mercaptoethylamine, and aminoethylisothiuronium). The administration of (I) induced a 15-20% higher O_2 tension in brain tissue, but giving (II) had no effect on O_2 tension in the brain. After (I) was administered, hypoxia was noted in the spleen (O_2 tension was 55-60% of the original level). The differing physiological action of (I) and (II) on the central nervous system, which enables different mechanisms of their antiradiation action to be proposed, is pointed out. (Referativnyy Zhurnal, Biologicheskaya Khimiya, No. 19, Oct. 1963)

9931 EFFECT OF COMPLEX COMPOUNDS CONTAINING THE TRACE ELEMENTS MANGANESE AND ZINC ON THE COURSE OF RADIATION SICKNESS IN MICE. A. Kh. Akhmadieva and M. N. Khasankhanova. p.346-9 of "Sbornik, Nauchnye Trudy Nauchno-Issledovatel'skogo Instituta Rentgenologii, Radiologii i Onkologii, Uzbekskoi SSR." 1962.

It is shown that in irradiation of mice (dose of 700 r) the preparation Mn-I (complex preparation containing Mn) increases the survival rate of rats from 17 to 56%, no substantial effect being registered on the leukocyte number in the blood of the mice at various times following irradiation. The preparation Zn-I (complex preparation containing Zn) reduces the survival rate of mice from 28 to 16%, although it inhibits a drop in the leukocyte number in irradiated animals and accelerates the restoration of this index. (Referativnyy Zhurnal, Biologicheskaya Khimiya, No. 19, Oct. 1963)

Radiation Hazards and Protection

9932 (AD-402259) ENERGY DISSIPATION CHARACTERISTICS IN TISSUE FOR PHOTON RADIATION IN SPACE. I. COMPARATIVE ANALYSIS OF THE LET SPECTRA OF MONOENERGETIC, FLARE PRODUCED, AND FISSION NEUTRON RECOIL PROTONS. Report No. 24. Hermann J. Schaefer (Naval School of Aviation Medicine, Pensacola, Fla.). [1963]. 11p.

Based on the definition of local energy dissipation as produced by collisions transferring less than 100 electron volts, the LET spectra of flare-produced and neutron-recoil protons from thermal fission are established and compared to the corresponding spectrum of standard x rays A striking similarity is obtained between the spectra of flare protons and of x rays whereas the recoil proton spectrum is basically different, centering heavily on LET values about and above 10 kev/micron tissue. In the latter LET interval, flare protons dissipate only a few per cent of their total energy. This indicates that the bulk of the ionization dosage from flare protons should be assigned the RBE of 1.0 with only a fraction requiring elevated RBE values. (auth)

9933 (FTD-TT-62-1692) PROTECTION FROM RADIOACTIVITY. S. N. Ardashnikov, S. M. Gol'din, et al. Translation from p.1-420 of "Zashchita ot Radioaktivnykh Izlucheniy," Metallurgizdat, 1961. 542p.

The book considers questions of radiation protection from the physical, chemical, and biological points of view. Commercial electronic dosimetric apparatus and procedures for its use are described. The principles of nuclear physics and electronics are reviewed briefly. (D.L.C.)

9934 MEASUREMENT OF TISSUE DOSES OUTSIDE OF THE REACTOR SHIELD. I. B. Keirim-Markus, V. T. Korneev, V. V. Markelov, and L. N. Uspenskii. At. Energ. (USSR), 15: 386-93(Nov. 1963). (In Russian)

In order to evaluate the contribution of epithermal neutrons to the tissue dose at a point outside of the reactor shield, a series of devices, designated as RUS-2,3,4, and 5 were built. The system included scintillation counters as slow-neutron detectors; a second counter provided with a Cd shield recorded only epithermal neutrons with energies higher than 0.4 to 0.5 Mev. The tissue dose was determined by taking the effect of the Cd shield into account in the reading; the error of the measurements amounted to about 30%. In some of the devices a special moderator was also included. The flux measurements and the dosimetric determinations were carried out on the basis of 1100 n/cm^2 corresponding to about 1 μrem/sec, using the

IRT-1000 reactor of the Kurchatov Institute because its shield configuration is widely employed for other research reactors. The data obtained showed that the dose level at all the service areas was below the maximum permissible level. It was also found that previous measurements, made with the RPN-1 device which records only the thermal and the fast neutrons underestimated the dose by a factor of about 1.5 for water and about 5 for concrete shields. (TTT)

9935 HAZARDS OF RADIATION. Brit. Med. J., 2: 716-18(Sept. 15, 1962).

A recent report of the U.N. Committee on the Effects of Atomic Radiation is discussed with emphasis on the genetic damage that follows any dose of radiation, however small. It is pointed out that it will be many years before clear-cut technical resolution is possible, but recent work indicates that as knowledge increases so does our awareness of the deleterious effects of even low doses of radiation. Everyone is exposed to radiation from natural sources of about 100 mrad per yr, which varies by 20% from place to place in the British Isles. It is approximately the same for the dose to the bone marrow, significant as a somatic target, and for the gonads, significant as the genetic target. It is roughly estimated that this level might be producing about 10% of some of the neoplastic diseases which occur naturally, e.g., leukemia, as well as 10% of the new mutations added to the pool of genetic damage. On this estimate, and on a linear type of dose-response relation, can be based the decision whether additional radiation exposure is justified either to an individual or to a population in the light of the risk involved. So far as the genetic effects are concerned any additional radiation exposure increases the risk of genetic damage in the population, and the genetically significant exposure of the population must be kept to a minimum. For those occupationally exposed, a different criterion has been used, and a so-called permissible level has been established. With increasing knowledge of the effects of radiation, the limit of this permissible dose has been decreased from 100 rad/yr in 1928 to 15 rad/yr in 1947, and more recently to 5 rad/yr. For the general population, the permissible dose is 10% of this. Similar reductions have been made in the maximum permissible radioactivity in foodstuffs. This trend of increasing caution with increasing knowledge is likely to continue, it is inferred. Even tracer doses of tritiated thymidine incorporated in the nucleus of leukemic lymphocytes may increase their ability to induce leukemia. The data are summarized relating to the possible effects of radiation on the fetus. It is concluded that pelvic x irradiation should be discouraged except during the 9 days after the onset of a regular menstruation, as a simple precaution which could be instituted more widely in medical practice. The genetic consequence of fetal irradiation also is discussed as a problem different from that of the adult. A study of 734,243 children indicates a cancer-mortality rate 40% higher in those prenatally x rayed than in the non-x-rayed population. The mean dose to the fetus was of the order of 2000 mrems, given at one time, that is, 20 times the background level spread out over a year. From these figures it is estimated that the doubling dose for these late somatic effects in the fetus is of the order of 6 rad, about $\frac{1}{3}$ of that estimated by the United Nations Committee as the doubling dose for similar effects in the adult. Several other reports relating to growing radiation hazards are discussed. (BBB)

9936 RADIATION HAZARD TO PATIENTS. A. C. Glendinning. Brit. Med. J., 2: 745(Sept. 21, 1963).

It is suggested that most diagnostic radiologists are familiar with the main recommendations of the Report of the Adrian Committee on radiation hazards and aware of the types of x-ray examination which are undesirable from the viewpoint of radiation hazard. At the same time the fact remains that it is a universal practice in England for requests for x-ray examination to be made wholly by the clinical staff, and frequently by junior staff, very few of whom have even seen the report. This means that patients sent for skeletal examination are seldom seen by the radiologist at all, and those who are subjected to a possibly superfluous gastrointestinal investigation are usually on the screening stand when the radiologist meets them. It is proposed that it is necessary to reveal to practitioners other than radiologists the basic rules set out by the Adrian Committee. If these were generally observed it would remove much of the radiation hazard and at the same time relieve the radiologist from informing his clinical colleagues of the hazard. The directive should come from, and with the authority of, the Adrian Committee itself. (BBB)

9937 INVESTIGATION OF RADIATION EFFECTS ON CANCEROGENIC AND NONCANCEROGENIC AZO DYES. W. Damerau (Institut für Biophysik, Deutsche Akademie der Wissenschaften, Berlin). Monatsber. Deut. Akad. Wiss. Berlin, 5: 507-11(1963). (In German)

The radiation effects on some cancerogenic and noncancerogenic azo dyes were investigated with the help of electron spin resonance. A relation between radiation effects and cancerogenic activity was not recognizable. (tr-auth)

9938 IMPLICATIONS OF IODINE 131 IN FALLOUT. M. F. Brink and M. S. Read (National Dairy Council, Chicago). Public Health Rept., 79: 25-31(Jan. 1964).

Iodine-131 has a half life of approximately 8 days. Fallout, which comes primarily from the troposphere, is therefore significant only within weeks after a nuclear explosion. Dairy cows secrete in their milk approximately 6% of the amount of I^{131} they ingest. Because of the short time interval between the processing of milk and its consumption, milk is believed to be the primary source of I^{131}. Approximately 30% of the ingested quantity of I^{131} is concentrated in the thyroid gland. However, no case of thyroid cancer in man has been found to be caused by I^{131}. The radiation protection guides established by the Federal Radiation Council are based on lifetime exposures, primarily for industry. These guides are not a dividing line between safety and danger, and they are not intended to dictate when or what kind of action should be taken. Averages for intake levels are based on infants and young children. Exposures many times the guide levels would probably not result in an increased incidence of disease. (auth)

9939 RADIODIAGNOSIS IN RELATION TO RADIOPROTECTION OF THE EYES. Ahti Rekonen, Carl-Erik Unnerus, and Erkki Vauramo. Suomen Laakarilehti, 17: 545-61(Mar. 10, 1962). (In Finnish)

Prevention of overexposure of the radiologist's eyes during fluoroscopy is discussed. (BBB)

Radiotherapy and Radiodiagnosis

9940 (NP-13512) DIAGRAMA PARA EL CALCULO DE DOSIS TOTALES DEBIDAS A FUENTES UNIFORMEMENTE DISTRIBUIDAS. Informe No. 94. (Diagrams for the Calculation of the Total Dose Received from Uniformly Distributed Sources. Report No. 94). A. E. Placer, R. B. Bravo, H. A. Mugliaroli, and O. R. Moll (Argentina. Comisión Nacional de Energía Atómica, Buenos Aires). 1963. 9p.

The calculation of the dose received from uniformly distributed sources can become a routine operation in radiotherapy and radiodiagnosis. In order to facilitate such operations, a diagram was constructed with which the total dose received can be easily calculated for any isotope in any body location. The theory of the construction of the diagram is discussed, and an example of its use is given. (J.S.R.)

9941 (NP-tr-1089) A NEW METHOD FOR THE PREPARATION OF COLLOIDAL CHROMIC PHOSPHATE. STUDY OF THE MECHANISM OF FORMATION AND BIOLOGICAL BEHAVIOUR. B. Bellion, G. Buchi, et al. Translated by E. Storey (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.), from Minerva Nucl., 6: 199-208(1962). 36p.

A method for the preparation of colloidal chromic phosphate (P^{32}) is described. Measurements of the stability, detection of soluble phosphate ions, and distribution of the colloid after injection into the foot-pad of rabbits, are also reported. (auth)

9942 RADIOLOGIC TELEVISION: ITS PHYSICAL, PHYSIOLOGIC, AND PATHOLOGIC PROBLEMS. M. Noix. Acta Iberica Radiol.-Cancerol., 18: 119-34(Apr.-June 1963). (In French)

Use of television to reduce radiation exposure in fluoroscopy is discussed. (BBB)

9943 CALCULATION OF THE ABSORPTION OF THE γ-ENERGY IN HETEROGENEOUS MACROSYSTEMS. B. M. Terent'ev, V. A. El'tekov, and D. I. Golenko. At. Energ. (USSR), 15: 382-6(Nov. 1963). (In Russian)

Determination of the total absorbed dose of γ radiation in the irradiated system represents one of the problems of radiobiological and medical studies. An attempt was made to clarify the problem by determining the distribution of the absorbed energy between the various components of the medium, using a Monte Carlo type calculation on the Strael-3 computer. The complex heterogeneous system considered consisted of cylindrical, water-equivalent bodies, cylindrical γ sources placed either within or outside of the irradiated bodies, and auxiliary components. The average energy of the spectrum of the radiation from the Co^{60} source was 1.25 Mev. The calculation involved the creation of a model of the generation and the trajectory of a gamma quantum and the determination of the Compton scattering and allowed the efficiency coefficients in air, water, Plexiglas, and brass to be determined. Treatment of 200 to 300 tracks was found to yield statistically meaningful values. Results of this semi-empirical method agreed with previously obtained experimental data. (TTT)

9944 NEUTRON THERAPY. Stephen Black. Brit. Med. J., 2: 324(Aug. 3, 1963).

Critical comment is advanced to a previous publication stating that in neutron therapy a dose of neutrons is more effective if divided into several fractions than if given in a single exposure, and which compares this with the effects of an x-ray dose similarly fractionated. The general question of the fractionation of biological stimuli and the different responses obtained are discussed. (BBB)

9945 LYMPH NODE RESPONSE TO HIGH-DOSE INTRALYMPHATIC INJECTION OF RADIOCHROMIC PHOSPHATE. Robert H. Burger (New York Medical Coll., New York). Bull. N. Y. Acad. Med., 40: 142-7(Feb. 1964).

Direct intralymphatic injection of radioactive chromic phosphate particles is a simple, convenient way of delivering tremendous doses of strong beta radiation to a series of localized lymph nodes draining a local area. The doses and volumes of isotope employed can saturate and destroy nodal tissue proximal to the site of injection. Radioactive $CrP^{32}O_4$ particulates are very susceptible to entrapment by and remain in the lymph node long enough to exert their therapeutic effect. (P.C.H.)

9946 REPRESENTATION OF A FUNCTION BY ITS LINE INTEGRALS, WITH SOME RADIOLOGICAL APPLICATIONS. A. M. Cormack (Tufts Univ., Medford, Mass.). J. Appl. Phys., 34: 2722-7(Sept. 1963).

A method is given of finding a real function in a finite region of a plane given its line integrals along all straight lines intersecting the region. The solution found is applicable to three problems of interest for precise radiology and radiotherapy: the determination of a variable x-ray absorption coefficient in two dimensions; the determination of the distribution of positron annihilations when there is an inhomogeneous distribution of the positron emitter in matter; and the determination of a variable density of matter with constant chemical composition, using the energy loss of charged particles in the matter. (auth)

9947 DIAGNOSTIC RADIATION AND EARLY PREGNANCY. George W. Brown (Georgia Radiological Society, Atlanta). J. Med. Assoc. Georgia, 52: 181(Apr. 1963).

The enhanced sensitivity of developing fetal cells to radiation requires those who use x rays diagnostically to take special or unusual precautions at times, especially since background radiation has been increasing in recent years. The referring physician and the radiologist should be ever cognizant of the possibility of early pregnancy in all female patients of child-bearing age; only by their joint effort can absolute min exposure to ionizing radiation in early pregnancy be obtained. (BBB)

9948 INTERPRETATION OF THE RESULTS OF CURIE-PUNCTURE BY THE CALCULATION OF DOSES. P. Jacob and J. S. Abbatucci (Centre Anticancereux, Caen, France). J. Radiol. Electrol. Med. Nucl., 43: 71-4(Jan.-Feb., 1962). (In French)

In 38 cases of Ra-treated oral cancer, measurements of dosage were made by means of a Mussell device (Br. J. Radiol., 29: 402(1956)), in which the Ra implant is inserted in a suitable phantom, to ascertain the amount of radiation received by the tumor and various anatomic structures around it. Isodose curves were calculated for various Ra doses. All cases were subjected to 1000- to 5000-r doses of conventional 200-kv x-ray treatment with supplementary Ra needle implantation. It was concluded that the lower dosage (<8500 r) was safer and that tumor cell destruction became less efficient at higher doses. It was also concluded that the Mussell technique for measuring tumor dosage is more accurate than traditional methods. (TCO)

9949 SCINTILLATION WELL COUNTER. Yu. A. Akatov, V. I. Popov, and N. A. Kanevskaya (All-Union Scientific Research Inst. of Medical Instruments and Equipment, USSR). Med. Prom. SSSR, 17: No. 9, 50-3 (Sept. 1963).

Radiodiagnostic methods are described for: determination of hormonal iodine in the blood and its excretion with urine in diagnosing disorders of the thyroid (I^{131} isotope); determination of the volume of circulating blood and plasma in the organism by using I^{131}-labeled albumin; determination of the volume of circulating erythrocytes and their longevity (Cr^{51} isotope); diagnosis of malignant plethora through use of Co^{60}-labeled vitamin B_{12}; determination of lost blood in hemorrhages from the gastrointestinal tract, the urinary system, and also in operations (Cr^{51} isotope). The scintillation counter operates on the principle that

part of the energy lost by the irradiation into the detector volume is transformed into light bursts, which are registered by a photoelectric multiplier. To measure the activity of the various biological samples labeled by radioactive isotopes, both liquid and solid scintillators are used. When a liquid scintillator is used, the sample is directly inserted into the detector space: it either is dissolved therein or remains in suspension form. Isotopes used in the methods described give off gamma-quanta type energies in the 0.1–1.33 Mev range. (OTS)

9950 PRE-OPERATIVE RADIATION THERAPY: BIOLOGICAL BASIS AND EXPERIMENTAL INVESTIGATION. W. E. Powers and L. J. Tolmach (Washington Univ., St. Louis). Nature, 201: 272-3(Jan. 18, 1964).

The effect of pre-operative irradiation on the surgical cure rate of transplanted, solid, subcutaneous 6C3HED tumors in C3H mice was investigated. Mice bearing transplanted tumors in the flank were randomly placed into 4 groups. The mice in groups 2 and 3 received a single 500 rad dose to the tumor site and surrounding skin. The dose rate was 420 rads per minute at a focal skin distance of 20 cm. The tumors in the mice of groups 3 and 4 were excised immediately after the animals were removed from the therapy room. Mice were examined daily for delay of wound healing, tumor recurrence and death. All mice not dying have been alive and well for 6 months (10 times the period needed for reappearance of the slowest developing tumor) and are considered cured. Statistical analysis (χ^2 test) showed that the difference in cure rates between the animals of groups 3 and 4 is highly significant (P = 0.001). (P.C.H.)

9951 CERVICAL CARCINOMA IN SITU AND ANAL SQUAMOUS-CELL CARCINOMA FOLLOWING RADIATION THERAPY FOR SQUAMOUS-CELL CARCINOMA OF CERVIX. A. W. Cavins. Obstet. Gynecol., 22: 524-6(Oct. 1963).

A case report is cited illustrating the development of carcinoma of the uterine cervix 18 yr after successful radiation treatment of a previous cervical carcinoma. The 23-yr-old patient had a rapidly growing squamous-cell carcinoma of highest grade of malignancy in 1943. She was given deep x-ray therapy using 4 ports, 10 × 15 cm, 200 kv, and 20 ma on 20 different days for a total of 6720 r (168 r to each of 2 ports per treatment). Radium in a total dose of 5400 mg-hr was also given. Subsequent repeated examinations showed total disappearance of the tumor, but in 1961 a cervical biopsy showed carcinoma in situ with no evidence of invasive or recurrent carcinoma. Recovery from this presumably primary tumor was complete but another apparently primary tumor developed in the rectum, diagnosed as a moderately differentiated squamous-cell carcinoma. Eight previously reported cases of such an in situ carcinoma developing after radiotherapy are reviewed. Various sequelae of radiation injury of the gastrointestinal and genitourinary tracts are described as a result of pathologic study of the case and their significance discussed. (BBB)

9952 LIMITATIONS OF THE USE OF RADIATION FOR DIAGNOSTIC AND ENDOCRINE THERAPEUTIC PURPOSES IN GYNECOLOGY AND OBSTETRICS. Pedro Figueroa Casas. Prensa Med. Arg., 48: 771-81(Mar. 1961). (In Spanish)

A comprehensive review deals with human responses to all sources of radiation, both natural and artificial. The rise in radioactive contaminants of air, water, and food is discussed. Emphasis is placed on data concerning the effects on genetic factors, in the general population, of the increased use of ionizing radiation, principally in the form of x rays. The use of radiation therapeutically in gynecology and obstetrics is discussed. It is concluded that in humans the immediate effects do not confirm geneticists' predictions. It is suggested that there has been an excessive tendency to extrapolate to the human, without due caution, results obtained in experiments with rats and fruit flies. It is pointed out also that in animal experiments, the same amount of radiation can produce different effects depending on how it is applied. It is concluded that the cautious use of radiation by qualified medical practitioners entails relatively low risk of somatic, and especially genetic, injury to humans. (BBB)

9953 AN ATTEMPT TO DEVELOP A RADIOACTIVE DRUG FOR CANCER THERAPY. J. S. Mitchell (Addenbrooke's Hospital, Cambridge, Eng.). Proc. Roy. Soc. Med., 56: 651-4(Aug. 1963).

Investigations were conducted on tritiated derivatives of 2-methyl-1, 4-naphthaquinol-bis-disodium phosphate (Synkavit, or Compound 1) for selective irradiation of tumors. This compound, investigated since 1946 as a therapeutic radiosensitizer, was found unexpectedly to concentrate to some extent selectively in the malignant cells of some human and animal tumors. Investigations with Compound 1 labeled with C^{14} in the methyl group confirmed its uptake and retention in some human tumors, and Compound 1 was labeled with tritium in position 3 of the nucleus, but the product had too low a specific activity for clinical use. Studies were also done on the tritiated drug 2-methyl-5, 6,7-tritritio-1,4-naphthaquinol-bis-disodium phosphate, which has 3 firmly bound tritium atoms per molecule and a specific activity of 87.3 μC/millimole with 1 μC contained in 4.88 mg of compound. The tritium is introduced by reductive dehalogenation of the corresponding tribromo derivative, 2-methyl-5,6,7-tribromo-1,4-naphthaquinol-bis-disodium phosphate using carrier-free tritium in the presence of a catalyst. It is referred to as TRA 119. A method of tritiation was devised which made it possible to obtain a compound containing approximately 1 atom of tritium per molecule with the tritium firmly bound. This compound is 2-methyl-6-tritio-1,4-naphthaquinol-bis-disodium phosphate, TRA 72. It was used in the treatment of 21 patients seriously ill with advanced, recurrent, radioresistant, or refractory malignant disease. Temporary improvement was observed in 5 and probably some improvement in a further 4 cases. Specific activity of biopsied specimens of tumor was almost invariably higher than that of bone marrow and of skeletal muscle, often by a factor of 3 and sometimes of 6 to 7. Similar therapeutic results were obtained with TRA 119, and no toxic effects were noted when single intravenous doses of 9.6 to 10.9 c of TRA 119 were administered. For most of the specimens of tumor taken 30 min after administration of TRA 119, the specific activity was between 25 and 300 μC/g of wet tissue. The results of the autoradiographic and related studies also provided evidence for selective concentration of TRA 119 in tumor cells in relation to normal cells in some cases of certain types of malignant disease. The estimated doses of radiation delivered by the tritium were consistent with the clinical findings that after intravenous injection of TRA 119, palliative effects may be produced in cases of highly radiosensitive conditions, such as testicular seminoma and Hodgkin's disease, and also in certain cases of slowly progressive recurrent adenocarcinoma of the gastrointestinal tract. (BBB)

9954 A COMPLICATION OF STEROID TREATMENT AFTER RADIOTHERAPY OF CARCINOMA OF THE UTERINE CERVIX. REPORT OF A CASE. Juan V. Fayos (Univ. of Michigan, Ann Arbor). Radiology, 82: 96-8(Jan. 1964).

A fatal case of unrecognized acute peritonitis following necrosis and perforation of the vaginal wall after radiation therapy for carcinoma of the cervix is reported. Steroids had subsequently been administered for an unrelated condition and are believed responsible for delaying healing through their anti-inflammatory effects, thus causing the perforation and masking the development of the peritonitis. It is recommended that steroids be avoided in any patient who has undergone intensive radiotherapy in the form of high-dose radium treatment, until the irradiated tissues have healed completely. (auth)

9955 RADIOLOGIC PROTECTION IN RADIOGRAPHY OF THE THORAX. Rev. Med. Chile, 91: 216-17(Mar. 1963). (In Spanish)

Precautions to be observed during radiography and fluoroscopy of the chest, particularly in reducing exposure of patient and radiologist, are discussed. This discussion originates from a meeting of the Sociedad Americana del Torax, held in July, 1959. (BBB)

9956 X RAYS AND RADIATION PROTECTION. Aaro Rytila. Suomen Laakarilehti, 17: 1729-46(Sept. 10, 1962). (In Finnish)

Overexposure of patients and personnel in fluoroscopic procedures is discussed, and methods for reducing their exposure, particularly by better training of radiologists in protective techniques, are outlined. (BBB)

9957 A SURVEY OF THE USE OF IONIZING RADIATION IN FINLAND DURING THE YEARS 1900-62. A. Rytila. Suomen Laakarilehti, 17: 2069-74(Nov. 1, 1962). (In Finnish)

A survey of dental and medical radiologic facilities in Finland showed that: the first medical x ray was made in Finland in 1900; the first law to enforce radioprotective measures in radiologic diagnosis was enacted in 1957; at the beginning of 1962 in Finland there were in operation in Finland 1197 dental, 1323 medical diagnostic, and 70 therapeutic x-ray devices, as well as 5 telegamma and betatron installations. (BBB)

9958 RESULTS OF TREATMENT OF HEMANGIOMA WITH APPLICATIONS OF RADIOACTIVE COBALT. L. P. Orlova (First Clinical Hospital of Minsk, USSR). Zdravookh. Belorusk., No. 8, 73-6(Aug. 1963).

Paraffin wax tablets containing Co^{60} and molded to conform to the area of the tumor were used in the treatment of 640 patients, including 606 infants (less than 3 years old): the usual dose was 50 (rarely 100) r/hr, the daily dose 200 to 300 r, and the total doses up to 2000 r. About 75% of the patients were girls. Cure was considered complete in 386, tumor size was decreased in an additional 156, tumor growth was arrested in 85; there was no effect in 13. Complete clinical data are detailed and tabulated. (OTS)

9959 AUSÜBUNG DER HEILKUNDE MIT RADIOAKTIVEN STOFFEN. (The Practice of Medicine with Radioactive Isotopes). Heinz Lossen. Stuttgart, Georg Thieme Verlag, 1962. 174p.

Texts of laws and regulations in the Federal Republic of Germany for doctors, dentists, veterinarians, and pharmacists on the use of radioisotopes are given. Excerpts are given from the basic laws of the Federal Republic of Germany. German atomic energy legislation is presented. International agreements are also included. (M.C.G.)

CHEMISTRY

General

9960 (BNL-7665) DECONTAMINATION METHODS, EQUIPMENT AND MATERIALS. Lee Gemmell (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT-30-2-GEN-16. 23p. (CONF-277-2)

From Symposium on Radiation Emergencies in Medicine, Research, and Industry, Chicago, Dec. 1963.

A survey is presented of decontamination methods and materials and their use at Brookhaven. Special problems of decontamination are considered. Decontamination methods and criteria for their use are given. Decontaminating agents and materials used at Brookhaven are described, and an account is given of the accident and decontamination experience at Brookhaven. (D.L.C.)

9961 (IDO-16911) ORGANIC COOLANT RESEARCH SUMMARY REPORT, JULY 1, 1960–MARCH 31, 1963. J. C. Hillyer (Phillips Petroleum Co. Research and Development Dept., Bartlesville, Okla.). Oct. 1, 1963. Contract AT(10-1)-1080. 72p.

A summary of work done in a study of problems related to the use of organic liquids as reactor moderator-coolants is presented. A major part of the study was devoted to the mechanism of radiolytic damage to coolants. A mathematical treatment for handling information on the relative reactivity of different positions on an aromatic ring was developed in some detail. Determinations on products from the radiolysis of terphenyls, biphenyl, and mixtures of these with benzene indicate that free radicals may be the main reactive species generated but that others are present. Comparison of the data with reactions of chemically or photochemically generated free radicals shows that the radiolysis is not random, especially at 300°C, but that meta radicals are more frequently formed. Attack by the active species on another molecule is favored in the para position and repressed at the ortho position compared to the meta. The distribution of isomers found indicates that H_2 abstraction by the free radicals and isomerization reactions do not occur to an appreciable extent. New analytical methods were developed. Chromatography on a solid salt column using LiCl proved to be a very satisfactory method for quaterphenyls and most hexaphenyls. Elution peak shifts between LiCl, CsCl, and $CaCl_2$ columns were correlated with structure, and made possible separation and identification of certain isomers not possible on a single column. For the calibration of the columns and position identification, authentic samples of all the quaterphenyls, several quinquephenyls, and 13 hexaphenyls were obtained or synthesized by unequivocal methods. Several of these were obtained in fairly large quantity and five were new compounds. Using these known materials, important correlations were developed in the fine structure of the infrared spectra which, together with the elution peak shifting between salt columns, made possible identification of many additional isomers for which calibration samples were not available. 9,10-Dihydrophenanthrene was found to give only 17% as much polymer as terphenyl under irradiation. It appeared to function as a H_2 donor and was the most promising of this type of new coolant. A concept of "self-healing" coolants was developed, which offers an attractive field for further research. A survey of candidate stabilizers revealed that radiolysis of terphenyl could be reduced 15 to 25% by addition of 3 mole % of compounds either containing divalent S or compounds having the anthracene ring system but with the central ring containing N, S, O, or Se atoms at one or both positions. An even more effective and much cheaper stabilizer was elemental S, which was most effective at 0.7 mole %. Apparatus was devised in which the deposition of film from contaminated coolant under electron irradiation and pyrolytic conditions could be studied, including circulating loops in which cells simulating fuel element coolant channel geometry and other types could be used. In these tests with spent reactor coolant containing high-boiling polymer and inorganic particulate matter it was found as the Fe concentration increased the amount of film increased linearly if sufficient organic polymer was present for a binder. The relationship of binder concentration to film deposited varied with the device used. Film thickness increased exponentially with surface temperature and was inversely proportional to coolant velocity in a non-corroding (stainless steel) system. There was evidence of a positive effect of beta current on film deposition. A H_2 blanket did not reduce the amount of film deposited, but there was less reduction in heat transfer due to reduction of the oxide in the film to metal. In corrodible mild steel systems, film deposition appears to be proceeding also by another mechanism in which mass transport of Fe in solution from the external system and deposition accompanied by a phase change is the route followed. Characteristic films were deposited from coolant containing Fe chelated with oxygenated organic compounds similar to those which might result from oxidation of irradiated coolant. Irradiated coolant, when exposed to air, developed the ability to corrode Fe, and films could be deposited from the resultant contaminated coolant. CO was found to result from irradiated coolant oxidation and to carburize iron oxide deposits on heat transfer surfaces. The new phase, iron percarbide, formed a tightly adhering film. Iron oxide precipitated in the bulk coolant did not reach a sufficient temperature to undergo this change. Some evidence for corrosion and transport by Cl compounds also was seen. Inexpensive, highly aromatic oils available as residues from fluid cracking and other operations in petroleum refineries showed some promise as candidate coolants. After desulfurizing and hydrodealkylating, some fractions were produced which had lower rates of degradation to polymer than terphenyls and were thermally stable up to 700 to 725°F. A fruitful field for further research was indicated. A process for reclamation of degraded coolant by catalytic hydrocracking was developed. A catalyst-screening program showed that the desired small degree of cracking ability together with little ring hydrogenation, promotion of the hydrogenation of the cracked fragments, and low coke formation could be obtained in cobalt molybdate, nickel oxide, or Pt preparations on low-surface-area, basic, alumina support. Applied to high boiler in a low-conversion recycle process, radiolytically and thermally stable coolant-range product was produced in 80% yield. A more desirable operation was application of the process to total spent coolant. Regenerated coolant was recovered in 95% or better yield, and with utilization of the H_2 liberated in reactor operation, the goal of closed system operation was approached. (auth)

9962 (TID-7675(p.122-56)) HYDROLYSIS AND RESIDUE ADSORPTION OF PROTACTINIUM. H. W. Kirby (Oak Ridge National Lab., Tenn.).

The hydrolytic behavior of protactinium in dilute sulfuric acid solutions is discussed. Results are given of a preliminary study of the residue adsorption method for the sequential separation of Pa^{231} from Ac^{227}, Th^{227}, and Ra^{223}. The desorptive properties of various reagents for these substances sorbed on metal plates are described. (D.L.C.)

Analytical Procedures

9963 (AERE-R-4483) ERRORS IN X-RAY FLUORESCENCE ANALYSIS. F. W. J. Garton (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Nov. 1963. 15p.

An expression for the variance of x-ray-fluorescence measurements is derived in which sources of error are conveniently grouped, thereby permitting an assessment of their relative magnitudes. An expression is also derived for the relation between line/background ratio and standard deviation, from which it is deduced that whereas at low values of the ratio the counting error is predominant and the standard deviation is virtually constant, at high values other sources of error may predominate and the coefficient of variation may become virtually constant. At intermediate values neither standard deviation nor coefficient of variation is constant and both may change rapidly with concentration. The effect of using an internal standard and the conditions for minimizing the additional counting error are also considered. (auth)

9964 (ASD-TDR-63-358) THE DETERMINATION OF TRACE AMOUNTS OF ZIRCONIUM AND TITANIUM IN TUNGSTEN. Ken F. Sugawara (Aeronautical Systems Div. Physics Lab., Wright-Patterson AFB, Ohio). May 1963. 18p. (AD-410582)

An extremely selective and sensitive method was developed for the determination of trace amounts of zirconium in tungsten. The selectivity is attained by utilizing ion-exchange in addition to liquid-liquid extraction techniques. The sensitivity is 5 ppm zirconium in tungsten. A method was also developed for the determination of trace amounts of titanium in tungsten. This method is not as selective as that for zirconium but is more sensitive. The sensitivity is 3 ppm titanium in tungsten. (auth)

9965 (CEA-2354) SEPARATION DU PLUTONIUM ET MESURE DE SA CONCENTRATION DANS LES EAUX NATURELLES. (Plutonium Separation and the Measurement of Its Concentration in Natural Waters). J. Scheidhauer, L. Messainguiral, and A. M. Meiraneisio (France. Commissariat à l'Énergie Atomique. Centre de Production de Plutonium de Marcoule, Chuscian). 1963. 9p.

After concentration by chemisorption on a calcium fluoride suspension, the plutonium is purified and isolated by xylene extraction of the complex formed with T.T.A. The radioelement is measured by counting with a ZnS (Ag) scintillator after evaporation or electrolysis. (auth)

9966 (CEA-2358) UTILISATION DE NEUTRONS DE 14 Mev EN ANALYSE PAR ACTIVATION. EXPERIENCES RELISEES AU C.E.N.G. (Use of 14-Mev Neutrons in Activation Analysis. Experiments Carried Out at the Grenoble Nuclear Research Center). G. Audouin, P. Guazzoni, and J. Laveriochere (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1963. 25p.

The use of 14-Mev-neutron irradiation makes it possible to extend the field of application of activation analysis to elements which cannot be activated in nuclear reactors (oxygen, boron, for example) or else to consider the possibility of "portable" measurement units for routine analyses. With this aim, tests have been carried out for studying the sensitivity and interferences in the case of the dosing of oxygen in eleven different matrices using 150 and 300 kv SAMES accelerators producing 14-Mev neutrons by the reaction $H^3(d,n)He^4$. The sensitivity of the dosage methods for six other elements has also been studied. The results obtained show that, for a neutron flux of 10^{10} n/4π, the sensitivities vary from 100 μg and 1 mg for oxygen in nine matrices (Be, Ta, Nb, Ti, Zr, Fe, Al, Sb, Si) and that it is possible to dose the six elements F, B, Y, Si, N, Al with sensitivities of between 1 and 1000 micrograms. (auth)

9967 (CEA-2359) SEPARATIONS PAR RESINES ECHANGEUSES D'IONS APPLIQUEES A L'ANALYSE PAR RADIOACTIVATION. (Ion-Exchange Resin Separation Applied to Activation Analysis). G. Aubouin and J. Laverlochere (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1963. 24p.

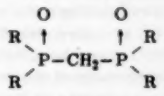
The separation techniques based on ion-exchange resins were used for carrying out activation analyses on about thirty impurities. A separation process was developed so as to standardize these analyses and to render their execution a matter of routine. The separation yields obtained are excellent and make it possible to carry out analyses on samples having a large activation cross section when working inside a reinforced fume-cupboard. This technique was applied to the analysis of impurities in tantalum, iron, gallium, germanium, terphenyl, and tungsten. The extension of this process to other impurities and to other matrices is now being studied. (auth)

9968 (CEA-2370) DOSAGE DE TRACES DE CARBONE DANS LE SODIUM. (Determination of Trace Carbon in Sodium). J. Sannier and A. Vasseur (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 8p.

A wet method for determining carbon in sodium was developed. The carbon is oxidized in a vacuum using Van Slyke's solution. The carbonic acid formed is measured volumetrically; its purity can be controlled by chromatographic analysis. The results obtained show that this method makes it possible to measure carbon in concentrations of about 10 ppm. (auth)

9969 (IS-737) SEPARATION OF VARIOUS CATIONS BY REVERSED-PHASE PARTITION CHROMATOGRAPHY USING NEUTRAL ORGANOPHOSPHORUS COMPOUNDS. Jerome W. O'Laughlin and Charles V. Banks (Ames Lab., Ames, Iowa). May 1963. Contract W-7405-eng-82. 145p.

The separation of a large number of cations by the reversed-phase partition chromatographic technique is reported. The use of neutral organophosphorus compounds and particularly bifunctional compounds of the type



as stationary phases is considered. Especial attention is given to the use of bis(di-n-hexylphosphinyl)methane (HDPM) as a stationary phase. Results obtained using this compound are compared with those obtained using tri-n-butyl phosphate (TBP) and tri-n-octyl phosphine oxide (TOPO). A large number of cations are readily separated on papers impregnated with TBP, TOPO or HDPM. The high partition coefficient for many cations, especially from perchloric acid media, into HDPM make this compound particularly useful as a stationary phase. The R_f or R_r values for many cations on TBP-, TOPO-, and HDPM-treated papers are given as a function of the acid concentration of the mobile phase. Aqueous solutions of nitric, hydrochloric, and perchloric acid as well as water were used as mobile phases. Separations of particular interest achieved on treated papers include Li from Na; Be, Mg, Ca, and Sr (or Ba) from each other; and the separation of the lanthanides from each other. Perchloric acid displaces Sr and Ba but not Be, Ca, or Mg on HDPM-treated papers

and a particularly sharp separation of the former two elements from the latter group is possible. Separations of the alkali and alkaline earth elements were also carried out on columns packed with an inert fluorocarbon polymer impregnated with HDPM. The R_f and R_r values obtained for the cations are discussed in relation to their partition coefficients into TBP, TOPO, and HDPM in some inert diluent. Previously unpublished partition data for a number of metal perchlorates into HDPM are presented. Generally the R_f or R_r values obtained were consistent with the known partition coefficient data. The partition coefficients for most metals increased (the R_f or R_r values decreased) as the charge to radius ratio of the unhydrated cation increased. A new spectrophotometric method for the determination of phosphine oxides is presented and the solubility is given as a function of temperature for several phosphine oxides in water and the mineral acids. An infrared spectrophotometric study of the adducts formed with HDPM by the metals and the mineral acids is also presented. (auth)

9970 (IS-777) PART I. EXTRACTION OF URANIUM, THORIUM, HAFNIUM AND THE ALKALINE EARTH ELEMENTS WITH BIS(DI-n-HEXYLPHOSPHINYL) METHANE FROM PERCHLORIC ACID SOLUTIONS. PART II. SIMULTANEOUS SPECTROPHOTOMETRIC DETERMINATION OF TRACE AMOUNTS OF CALCIUM AND MAGNESIUM WITH CHLOROPHOSPHONAZO III. Jerry Walter Ferguson and Charles Banks (Ames Lab., Ames, Iowa). Nov. 1963. Contract W-7405-eng-82. 43p.

The extraction of hafnium, thorium, uranium, magnesium, calcium, barium, and strontium with HDPM in 1,2-dichlorobenzene from perchloric acid solutions in a three to one molar ratio of HDPM to metal ion was studied. Most of the hafnium formed a precipitate between the phases. Thorium was nearly quantitatively extracted from all concentrations of perchloric acid. Uranium was quantitatively extracted from all concentrations of perchloric acid. The alkaline earth elements were not well extracted from any concentration of perchloric acid. The extraction of calcium was increased by using sodium perchlorate solutions rather than perchloric acid solutions. A rapid and sensitive spectrophotometric procedure for determining calcium and magnesium with Chlorophosphonazo III is described. Either calcium or magnesium may be determined at pH 7.0 in the range of 0.1 μg per 25 ml (0.004 ppm) to 10 μg per 25 ml (0.4 ppm). In mixtures of calcium and magnesium, calcium is determined at pH 2.2 at a wave length of 667.5 mμ. The magnesium is then determined by difference at pH 7.0 and 669 mμ where the absorbances of the two metal complexes are additive. Milligram amounts of the alkali metals can be tolerated, but most other metals interfere. (auth)

9971 (ORNL-TM-750) ORSTAT — A FORTRAN PROGRAM FOR THE STATISTICAL ANALYSIS OF DIFFRACTION DATA. H. L. Yakel (Oak Ridge National Lab., Tenn.). Feb. 3, 1964. Contract W-7405-eng-26. 11p.

The program ORSTAT calculates approximate scale and overall temperature factors for sets of relative x-ray diffraction intensities, performs statistical tests for symmetry elements, or performs both operations in sequence. Program operations and data input are described; and the FORTRAN listing of the calling program and subroutines is given, together with output of an analysis of the neutron diffraction intensity data for sucrose by the sequential procedure. (D.C.W.)

9972 (RFP-358) AN APPARATUS FOR THE PREPARATION OF STANDARD GAS MIXTURES CONTAINING TRACE LEVEL COMPONENTS. Evain D. Ruby (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). Feb. 5, 1964. Contract AT(29-1)-1106. 14p.

A gas blending system has been made for use in the preparation of standard gas mixtures. Blends can be made containing minor components at concentration levels down to 10 ppm by volume. These blends are used to calibrate various analytical instruments. (auth)

9973 (TID-19999) AN INVESTIGATION OF REMOTE LUNAR ANALYSIS BY NUCLEAR ACTIVATION ANALYSIS. Annual Report, May 1, 1962–April 30, 1963. Lloyd E. Fite, Edgar L. Steele, Richard E. Wainerdi, Edward Ibert, Pedro Jimenez, Charles Samson, and Maen To-on (Texas. Agricultural and Mechanical Coll., College Station. Engineering Experiment Station. Activation Analysis Research Lab.). Contract AT(40-1)-2671. 101p.

Techniques to permit the exploration of the lunar surface by an unmanned automatic nuclear activation analysis system coupled by telemetry to a computer on earth, were studied. A combination of neutron activation, gamma spectrometry, and computer reduction of data comprises the most promising method of nuclear analysis. It was determined that the neutron source must be as close to the sample material as possible during activation. After activation, the detector should be positioned as close to the sample material as possible, and then should begin to count as quickly as possible. A multichannel analyzer with 200 channels will resolve gamma-ray spectra from fast-neutron-irradiated samples. Gamma-ray spectral information can be stored on magnetic tape before the analog-to-digital conversion stage. (auth)

9974 (VDIT-83) SOME ANALYTICAL METHODS FOR THE DETERMINATION OF BORON IN PARTICULAR IN URANIUM. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Dec. 1963. 30p.

A total of 80 abstracts is presented on the determination of boron in uranium. The abstracts cover the period from 1957 to the beginning of 1963 and are arranged according to the methods used or the reagents employed for the determination. (D.L.C.)

9975 CHEMICAL ELEMENTS OF THE BLOOD OF MAN IN HEALTH. X-RAY SPECTROCHEMICAL STUDIES. John W. Gofman ((Univ. of California, Berkeley). Advan. Biol. Med. Phys., 8: 1-39(1962).

X-ray spectrochemical analysis was used to obtain an estimate of the mean level of 66 chemical elements in blood serum from a group of humans in ostensible health. Principles of x-ray emission spectroscopy are discussed and the analytical procedure used is described. (C.H.)

9976 NEUTRON ACTIVATION ANALYSIS. Kwan Hsu (Univ. of California, Berkeley). Advan. Biol. Med. Phys., 8: 41-80(1962).

The principles of neutron activation analysis are reviewed. Applications in biological and medical research using 24 elements are summarized. (103 references.) (C.H.)

9977 LOW LEVEL GAMMA-RAY SCINTILLATION SPECTROMETRY: EXPERIMENTAL REQUIREMENTS AND BIOMEDICAL APPLICATIONS. L. D. Marinelli, C. E. Miller, H. A. May, and J. E. Rose (Argonne National Lab., Ill.). Advan. Biol. Med. Phys., 8: 81-160(1962).

Applications of γ scintillation spectrometry in whole-body measurement of man for low-level natural radioactivity, contamination by fallout fission products in food and environment, and in medical tracer studies are discussed. Procedures and equipment are described. (143 references.) (C.H.)

9978 LIQUID SCINTILLATION COUNTING OF C^{14}-LABELED AMINO ACIDS ON PAPER, USING TRINITROBENZENE-1-SULFONIC ACID, AND A MODIFIED COM-

BUSTION APPARATUS. Claude F. Baxter and Ilse Senoner (City of Hope Medical Center, Duarte, Calif.). Anal. Biochem., 7: 55-61(Jan. 1964).

The sodium salt of trinitrobenzene-1-sulfonic acid was used to detect C^{14}-labeled amino acid spots on paper without removing radioactivity from the carboxyl group. Combustion of these paper spots was carried out in improved combustion vessels with recoveries of radioactivity from 96 to 100%. These techniques were used to compare the effect of chromatography and electrophoresis upon the recovery of radioactivity in labeled amino acids. (auth)

9979 PROCEDURE FOR SIMULTANEOUS ASSAY OF TWO β-EMITTING ISOTOPES WITH THE LIQUID SCINTILLATION COUNTING TECHNIQUE. Richard W. Hendler (Public Health Service, Bethesda, Md.). Anal. Biochem., 7: 110-20(Jan. 1964).

Two liquid scintillation counting techniques are described for the simultaneous assay of two β-emitting isotopes. Both methods are based on the empirical determination of the energy distribution for each isotope in various combinations of windows and the effects of known amounts of quenching on these distributions. One method is applicable for any level of radioactivity from extremely low to high ranges while the second is applicable for high levels of activity. Applications of the methods for the isotope pairs C^{14}, H^3 and C^{14}, P^{32} are discussed. (C.H.)

9980 THE EMISSION-SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN URANIUM-233 DIOXIDE AFTER PRE-CONCENTRATION OF THE RARE-EARTH ELEMENTS BY ION EXCHANGE. F. T. Birks, G. J. Weldrick, and A. M. Thomas (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Analyst, 89: 36-41 (Jan. 1964).

Twenty-nine impurity elements were measured directly in uranium-233 dioxide by the carrier-distillation method. Enhancement of some of the impurity elements (magnesium, bismuth, antimony, lead, manganese, zinc, cadmium, and indium) in the uranium dioxide matrix is shown. The precision of the carrier-distillation method was improved by using internal standard control. Rare-earth elements were determined by a spectrographic method after concentration by ion exchange, giving a total of 45 impurity elements determined for each sample. The uranium-233 is recoverable after the analysis. (auth)

9981 METHODS AND APPLICATIONS OF ACTIVATION ANALYSIS. Edward V. Sayre (Brookhaven National Lab., Upton, N. Y.). Ann. Rev. Nucl. Sci., 13: 145-62 (1963). (BNL-6941)

Basic principles, machines and sources for activation, advantages of different methods, and applications are discussed. 155 references. (R.E.U.)

9982 A METHOD FOR MATRIX CORRECTION IN THE SPECTROGRAPHIC DETERMINATION OF URANIUM. W. H. Dennen and A. V. Sankaran (Massachusetts Inst. of Tech., Cambridge). Appl. Spectry., 17: 44-7(1963).

The difference of relative intensity of U 4241A in various matrices is a thermal effect, which can be corrected by use of a temperature sensitive pair of titanium lines. This is illustrated using rock samples. (auth)

9983 ANALYSIS OF GALLIUM BY SPARK SOURCE MASS SPECTROMETRY. W. A. Wolstenholme (Associated Electrical Industries Ltd., Manchester, Eng.). Appl. Spectry., 17: 51(1963).

A method is described for the analysis of gallium for impurities by spark source mass spectrometry using self supporting gallium electrodes. Results indicate that it is possible to determine impurities with detection limits of the order of 0.01 ppm (atomic) for many elements. (P.C.H.)

9984 A NEW CARRIER FOR URANIUM OXIDE. H. G. King and C. M. Neff (Union Carbide Nuclear Co., Y-12 Plant, Oak Ridge, Tenn.). Appl. Spectry., 17: 51-3(1963).

A method is described for the analysis of uranium oxides for impurities by the carrier distillation method. A mixed carrier compound of AgCl and AgF was used in the ratio of 4 to 1 (chloride to fluoride). The weight of carrier per crater charge, as well as the mixture ratio, can be varied according to matrix and number of impurities desired. The results of analyses on U_3O_8 using the mixed carrier were compared with other methods and found to be significantly more precise. (P.C.H.)

9985 SPECTROGRAPHIC DETERMINATION OF TRACE AMOUNTS OF RARE EARTHS. II. ANALYSIS OF LANTHANUM, YTTRIUM, EUROPIUM, PRASEODYMIUM, NEODYMIUM, AND SAMARIUM BY THE CARRIER DISTILLATION METHOD. Z. Radwan, B. Strzyzewska, and J. Minczewski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Appl. Spectry., 17: 60-2 (1963).

A method for the spectrographic determination of trace amounts of Eu, La, Y, Nd, Pr, and Sm in 5N HCl solution was developed. The solution is evaporated on graphite powder and excited in the craters of graphite electrodes in a d-c arc using the carrier distillation method. CsF is used as the carrier. Excitation is made in the special atmosphere of 80% oxygen and 20% argon. For Y and La, the range of determination is from 0.25 to 10 μg/ml and for Eu, Nd, Pr, and Sm the range is from 0.5 to 20 μg/ml. The average coefficient of variation amounts to ±10%. It was found that in the investigated concentration range the influence of some rare earth elements on excitation of the others is negligible. The method can be applied also to the analysis of other rare earth elements. (auth)

9986 A RAPID INFRARED METHOD FOR THE QUANTITATIVE DETERMINATION OF D_2O-H_2O MIXTURES. Helga S. Fochler (Standard Oil Co. of Ohio, Cleveland). Appl. Spectry., 17: 105-6(1963).

A rapid infrared method for the quantitative analysis of relative amounts of D_2O and H_2O in mixtures as they are obtained in quantities as small as 0.01 ml from reaction mechanism studies off a gas chromatographic column is described. The method is independent of the sample concentration in the solvent because it is based on the absorbance ratios of the OH and OD stretching bands at 2.83 and 3.90 microns. The total water content is not measured although a high degree of accuracy on the relative concentrations of the two components is attainable. (P.C.H.)

9987 THE EFFECTS OF VARIOUS GRADES OF GRAPHITE ELECTRODES ON THE CARRIER DISTILLATION OF IMPURITIES IN U_3O_8. C. E. Pepper, A. J. Pardi, and M. G. Atwell (National Lead Co. of Ohio, Cincinnati). Appl. Spectry., 17: 114-19(1963).

Seven grades of graphite electrodes were evaluated for their effects upon the carrier distillation excitation of impurities in U_3O_8. Two carrier materials, AgCl–LiF (11 : 1) and Ga_2O_3, were independently investigated using a Wadsworth mount spectrograph and a Quantometer. Time resolved spectra for 19 impurities were made by recording the instantaneous response of each impurity in the arc for each type of graphite electrode. Elemental sensitivity comparisons were made from the measured area under each spectral recording. The analytical precisions of the elements (B, Cr, Cu, Fe, Mn, Ni, and Si) for each graphite type

were determined from replicate analyses of common U_3O_8 samples. The comparative precision data show that a selection of a graphite type, which provides the greatest advantages for determining impurities in U_3O_8 with carrier distillation techniques, can be made. (auth)

9988 ON A MODIFICATION OF THE THIOCYANATE METHOD OF NIOBIUM DETERMINATION. Jerzy Minczewski and Cezary Bozycki (Technical Univ. of Warsaw). Chem. Anal. (Warsaw), 8: 977-9(1963). (In Polish)

Determination of Nb using diethyl ether and carbon tetrachloride (1:1 ratios) proved more efficient than using diethyl ether alone. Good results were achieved with 10 ml of carbon tetrachloride, benzene, chloroform, or trichloroethylene added to ether extracts. Prepared Nb solutions were stable but dissociated on dilution. (R.V.J.)

9989 THE PREPARATION OF STANDARDS FOR NEUTRON ACTIVATION ANALYSIS. Miloslav Rakovič and Helena Talpova (Charles Univ., Prague). Chem. Listy, 57: 1183-6(Nov. 1963). (In Czech)

In determinations by neutron activation, it is recommended that standards be prepared by evaporation of a standard solution on a filter paper strip. By this method standards with the appropriate content of the element to be determined can be produced with sufficient exactness. The neutron self-absorption in the standard is thereby negligible. For packaging the samples and standards it is sufficient to fuse them in polyethylene tubes. Mineral impurities in the filter paper are not disturbed. (tr-auth)

9990 SELECTIVE DETERMINATION OF RUTHENIUM 103 AND RUTHENIUM 106 IN EFFLUENTS AND NATURAL WATERS. J. Scheidhauer and L. Messainguiral. Chim. Anal. (Paris), 45: 452-62(Sept. 1963). (In French)

Ru radioisotopes are extracted from radioactive effluents by CCl_4. The problem of destruction of certain complexes is solved. Ru^{103} is discriminated from Ru^{106} by a counting technique. The use of the described method for the separation of these two isotopes from natural waters is indicated. (tr-auth)

9991 SENSITIVITY AND PRECISION OF METHODS FOR ANALYZING TECHNICALLY PURE AND DILUTELY ALLOYED URANIUM. C. Hostein and R. Sifferlen. Chim. Anal. (Paris), 45: 634-40(Dec. 1963). (In French)

The determination of Al, Cr, Fe, Mn, Mo, Ni, Si, and Zr in U is reviewed. Principles and methods used for obtaining sensitivity and reproducibility are summarized. The concentration limits for which these methods are applicable, as well as the relative errors as functions of concentration, are given for each impurity element studied. (T.F.H.)

9992 AMERICIUM AND ITS ANALYTIC PROPERTIES. Christiane Ferradini (Faculté des Sciences, Paris). Chim. Anal. (Paris), 45: 647-52(Dec. 1963). (In French)

The chemical analytic properties of Am in its various valence states are studied, including the hydroxide, fluoride, phosphate, and oxalate. The possibility of extraction of acid solutions by organic solvents is reviewed, as regards Am(III) and Am(V). The difficulty of separating Am from its principal impurities (Pu and rare earths) is noted. The principal methods for determining Am, viz. absorption spectrometry of the tetra-, penta-, and hexavalent states and radiometry of Am^{241}, are reviewed. (T.F.H.)

9993 A NEW METHOD FOR THE DETERMINATION OF SOME GASEOUS FISSION PRODUCTS. André Bouville, Daniel Blanc, Jacques Couly, and Jacques Fontan (Faculté des Sciences, Toulouse). Compt. Rend., 257: 3585-7 (Dec. 4, 1963). (In French)

The method for the determination of natural radioactive gases (Nuovo cimento 23: Suppl. 1, 132(1962)) was adapted to the detection of artificial radioactive gases having a chain of solid descendants. The isotopes of Kr (88 to 97) and Xe (138 to 144) were the fission products studied. (tr-auth)

9994 DETECTION OF PLUTONIUM AEROSOLS IN THE PRESENCE OF CONSIDERABLE AMOUNTS OF URANIUM. A. M. Vorobev and V. P. Kuzmina. Gigiena i Sanit., No. 9, 54-5(Sept. 1963). (In Russian)

A method is described for determining Pu in the presence of large quantities of U. Pu is extracted using thenoyltrifluoroacetone (TTA) and precipitated using bismuth phosphate. In contrast to U (VI), plutonium (IV) is easily separated by TTA from 1M nitric acid and lends itself to quantitative precipitation. The yield of Pu amounted to 90%. The presence of U^{235} in quantities exceeding 200-fold the Pu content did not influence the determination in 10-mg specimens. The order of error was ±20%. (R.V.J.)

9995 COLORIMETRIC DETERMINATION OF BERYLLIUM IN WATER. Yu. N. Dunaeva. (Sverdlovsk Research Inst. of Industrial Hygiene and Pathology). Gigiena i Sanit., No. 9, 58-61(Sept. 1963). (In Russian)

A colorimetric method for determining beryllium in sewage using beryllon II is described. Be contents of 0.002 to 0.017 mg/l in sewage and 0.002 to 0.016 mg/l in water were determined. (R.V.J.)

9996 PURPUROGALLIN AND SOME RELATED COMPOUNDS AS ANALYTICAL REAGENTS: PART II. A SPECTROPHOTOMETRIC STUDY OF ZIRCONIUM COMPLEXES WITH 3′,4′-DIHYDROXYBENZOTROPOLONE. Yag Dutt and R. P. Singh (Univ. of Delhi). Indian J. Chem., 1: 471-2 (Nov. 1963).

The composition of the two chelates formed between zirconium and 3′,4′-dihydroxybenzotropolone was investigated employing absorbance measurements, and it was found that zirconium and 3′,4′-dihydroxybenzotropolone form 1:1 and 1:2 complexes. The color intensity of the complexes is maximum in 0.5-1.5N hydrochloric acid and the values of log K_1 and log K_2, determined by continuous variation and mole-ratio methods, in 0.8N HCl at 20°C and ionic strength of 0.8M, are 4.5 and 8.3, respectively. The complex obeys Beer-Lambert's law at 540 mμ in the concentration range 0.5-15 ppm of zirconium. Interference due to a number of cations and anions was also investigated. (auth)

9997 ANALYSIS OF URANIUM(IV) OXALATE. D. S. Bharadwaj and A. R. Vasudeva Murthy (Indian Inst. of Science, Bangalore, India). Indian J. Chem., 1: 493-4(Nov. 1963).

An accurate method for the estimation of uranium and oxalate contents in uranium(IV) oxalate was standardized by separating the components before their determination. Oxalate content is estimated by permanganate titration while uranium is determined by gravimetric method. (auth)

9998 SIMULTANEOUS ASSAY OF K^{42}, Na^{24}, AND Br^{82} IN BODY COMPOSITION MEASUREMENTS. E. A. Boling, E. Rossmeisl, R. McLean, H. Alpert, R. Gardner, M. Halpin, and J. B. Lipkind (Veterans Administration Hospital, Boston and Tufts Univ., Boston). J. Appl. Physiol., 18: 1252-6(Nov. 1963).

Simultaneous measurements of Na^{24} and K^{42} specific activities may be based on chemical, physical, or metabolic differences between the two radioisotopes. A rapid and precise technique based on both physical and metabolic differences is described. Two counters, a gamma and beta counter, are used. Two samples are collected from each patient at tracer equilibrium (40 hr after administration of

K^{42}, 50 μC; Na^{24}, 30 μC; Br^{82}, 20 μC): urine, which has a high chemical K:Na ratio, and serum, which has a low chemical K:Na ratio. The urine is counted in the beta counter, which favors K^{42}. The serum is counted in the gamma counter, which favors Na^{24}. To calculate the specific activities, equations are used that contain appropriate decay corrections, to permit calculation of the individual specific activities even though simultaneous counting of the samples in the two detectors is not required. The laboratory procedure is simple and straightforward, and the procedure gives results that are comparable in accuracy to methods that use only one isotope at a time. When counters of great sensitivity are employed, the procedure permits both small doses of radioisotope and long equilibrium periods (40 hr). Total exchangeable chloride can be estimated at the same time by Br^{82} dilution. The calculation was programed for a large digital computer. (auth)

9999 SCINTILLATION COUNTING OF PLASMA TRITIATED WATER (HTO). Gerald Moss (Albany Medical Center Hospital, N. Y.). J. Lab. Clin. Med., 63: 315-18 (Feb. 1964).

The determination of plasma HTO was conveniently carried out by liquid scintillation counting of pure water removed from the sample, undiluted and uncontaminated. This was accomplished by lyophilization (freeze drying). The process was made rapid and simple, without sacrificing precision, by use of a special manifold that handled 6 samples (or multiples) simultaneously. Counting rates were fivefold greater than by conventional methods employing protein removal by precipitation. The solutes did not undergo chemical or thermal decomposition, and were available for further study. Internal standards were not required. (auth)

10000 Sr-90 DETERMINATION IN THE BONES OF FETUSES AND CHILDREN. Hilde Levi, J. Lindemann, and A. Nielsen (Universitet, Copenhagen). Medd. Sundhedsstyr., 111: 839-40(Dec. 15, 1961). (In Danish)

A preliminary report of more complete data is presented. 555-8(Oct. 1962); cf. NSA, 17: 8451. (BBB)

10001 A COMPARISON OF METHODS OF DETERMINING BURNUP ON URANIUM DIOXIDE FUEL TEST SPECIMENS. R. G. Hart, M. Lounsbury, R. W. Jones, and M. J. F. Notley (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Sci. Eng., 18: 6-17(Jan. 1964).

A study of five methods of determining burnup in fuel test specimens was made to determine the confidence that can be placed in the burnup numbers so obtained. The five methods compared are uranium-235 depletion, cobalt monitoring, cesium-137 production, plutonium production, and calorimetry. The study includes a comparison of data obtained on portions of the specimen with that obtained on the complete specimen. It was found that all of the methods give burnup values that are within ±5% of the best burnup value, the best value being defined as the unweighted average of all the available results on a particular sample. The limitations and pitfalls of all the methods are discussed in some detail. It was further found that a complete cross-section of the test specimen, approximately ½ in. long, is sufficient sample to give representative burnup data. The integration from this to the complete specimen is relatively straightforward. Any sample not comprising a complete cross-section involves radial as well as longitudinal integration, giving results that are relatively uncertain, particularly in samples of high heat rating where migration of some species is a distinct possibility. (auth)

10002 ACTIVATION ANALYSIS FINDS ITS PLACE IN THE LIFE SCIENCES. Richard E. Wainerdi (Texas Agricultural and Mechanical Univ., College Station). Nucleonics, 22: No. 2, 57-60(Feb. 1964).

The role of activation analysis in the life sciences is discussed. A review is presented of some papers from the Third International Conference on Biology at Saclay, France, in Sept. 1963. Isotopic tracers are discussed. (R.E.U.)

10003 FASTER ANALYSIS FOR Pb^{210} IN BIOLOGICAL SPECIMENS. Arthur L. Aronson and Paul B. Hammond (Univ. of Minnesota, St. Paul). Nucleonics, 22: No. 2, 90; 92(Feb. 1964).

It was found that Pb^{210} activity in biological specimens can be evaluated prior to secular equilibrium with Bi^{210} by separating the two by dithizone extraction at pH 3.8 to 3.9 and holding the specimens at least 11 days before counting. The recovery of Pb^{210} from various tissues is reported. (R.E.U.)

10004 INSTRUMENTAL AND SOIL MOISTURE VARIANCE USING THE NEUTRON-SCATTERING METHOD. John D. Hewlett, James E. Douglass, and Jerome L. Cutter (U. S. Forest Service). Soil Sci., 97: 19-24(Jan. 1964).

The variation of soil moisture estimates determined by the neutron-scattering method was examined in theory and related to field data from two research areas. A statistical model is developed to account for error. Instrument and timing errors are shown to contribute insignificantly to the standard error of estimate in sampling studies. Furthermore, their contribution to estimates of moisture change with time is, for all practical purposes, negligible, as long as the timing interval used at each observation exceeds 30 seconds. In most studies even shorter timing intervals may be used safely. (auth)

10005 ANALYTICAL APPLICATIONS OF ARSENAZO III. II. DETERMINATION OF THORIUM, URANIUM, PROTACTINIUM, NEPTUNIUM, HAFNIUM AND SCANDIUM. S. B. Savvin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Talanta, 11: 1-6(Jan. 1964).

The particular analytical utility of arsenazo III is its capacity for forming especially stable complexes with certain elements. This permits determinations to be carried out in strongly acid media (for quinquevalent and quadrivalent elements — Pa, $Np^{(IV)}$, Th, Zr, Hf, $U^{(IV)}$ — up to 10 M HCl or H_2SO_4), which ensures good reproducibility, ease of working, and little interference by anions. The high sensitivity (0.1 – 0.01 μg/ml, molar absorption coefficient $50 - 150 \times 10^3$) is a result of the good contrast effect of the reaction (pink → emerald-green, displacement of the absorption maximum 125 mμ), the nature of the spectrum, and the possibility of reaching extreme dilutions without dissociation of the complex. (auth)

10006 ANALYTICAL APPLICATIONS OF ARSENAZO III. III. THE MECHANISM OF COMPLEX FORMATION BETWEEN ARSENAZO III AND CERTAIN ELEMENTS. S. B. Savvin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Talanta, 11: 7-19(Jan. 1964).

The two functional-analytical groups of the molecule of arsenazo III are present in two almost isolated conjugated systems. Complex formation with the elements takes place through only one of these: this leads to the appearance of two absorption bands in the visible region of the spectrum. The composition of the complexes for $Me^{(II)}$ and $Me^{(III)}$ correspond to MeR; and for $Me^{(IV)}$ to MeR or MeR_2 (according to the acidity and the concentrations of the components.) Elements whose ionic radii are less than 0.7 – 0.8 Å give no color reaction with arsenazo III. The stabilities of the complexes formed by reagents of the type of arsenazo III

(bis-azo derivatives of chromotropic acid) with elements depend on the nature of the Me–N bond, and are determined by the extent of the system of conjugated bonds of the molecule of the reagent and the nature of the substituent. (auth)

10007 RE-ACTIVATION ANALYSIS OF VANADIUM. Y. Kamemoto and S. Yamagishi (Japan Atomic Energy Research Inst., Tokyo). Talanta, 11: 27-32(Jan. 1964).

Re-activation analysis was applied to the determination of vanadium. After the addition of vanadium carrier to the irradiated sample, vanadium-52 is separated radiochemically pure by extraction with benzene as vanadium oxinate. The γ spectrum of the vanadium-52 is recorded; the height of the photopeak at 1.44 Mev is measured and compared with that of a vanadium standard. The chemical yield of the purification step is decided by re-irradiation of the separated vanadium oxinate solution and comparing the activity of the vanadium-52 with that of a further vanadium standard. The vanadium content of the sample is determined from the activity of the vanadium-52 induced by the first irradiation and corrected for the chemical yield from the second irradiation. (auth)

10008 THE NEUTRON METHOD OF DETERMINING BORON CONTENT IN ROCK SAMPLES. Yu-chun Chang. Ti Ch'iu Wu Li Hsueh Pao, 11: No. 1, 76-83(1962).

Results are presented of the application of the neutron method in the determination of the boron content in rock samples. A device with a Ro-Ve neutron source possessing an activity of 10^8/sec, a paraffin moderator, and a neutron detector was prepared for the purpose of carrying out the experiment. The method of analysis consists of relative measurements of the degree of the reduction of intensity of the neutron flux during the passage of moderated neutrons through the sample being studied and a standard sample under similar geometric conditions. The sensitivity threshold of the method amounts to 0.05% B_2O_3 in the case of a sample weighing 100 gms. (OTS)

10009 PHOTONEUTRON METHOD OF DETERMINING BERYLLIUM CONTENT IN ROCK SAMPLES. Yu-chun Chang. Ti Ch'iu Wu Li Hsueh Pao, 11: No. 1, 84-91(1962).

A device was designed and an apparatus with 6 proportional counters filled with boron trifluoride was prepared to be used as a moderated neutron detector. Sb^{124} is used as a gamma quanta source with a strength of 50 microcuries. The method of analysis consists of the relative measurements of the pulse counting rate obtained from the samples being studied and the corresponding standard samples, which are both irradiated with gamma quanta under similar conditions. The sensitivity threshold of the method amounts to 0.01% BeO in the case of a source activity of 50 microcuries and a sample weight of 100 gms. (OTS)

10010 STUDY ON THE APPLICATION OF RADIOCHEMICAL METHODS TO THE ANALYSIS OF METALS. I. ACTIVATION ANALYSIS OF IMPURITIES IN THE METALLIC SILICON OF HIGH PURITY. Minoru Chiba. Trans. Natl. Res. Inst. Metals (Tokyo), 4: 143-50(1962).

Metallic silicon of high purity was irradiated with thermal neutrons to analyze impurities radiochemically. As a result, it was found that the specimens contain an extremely small amount of copper. The quantities of copper were 0.25 ~ 0.32 ppm for the iodide silicon method, and 0.11 ~ 0.14 ppm for the trichlorosilane silicon method. The annihilation radiation of β^+ from Cu^{64} was counted with the single channel γ spectrometer using the well type NaI–Tl γ detector. The energy calibration and the counting efficiency of β^+ were determined by the standard sample of Zn^{65}. With this efficiency, the quantities of copper were determined from the activities of Cu^{64}. Chemical separation of copper from the matrix silicon was not carried out. There are many factors that have influence on the determination, such as fluctuations of neutron flux, uncertainty of irradiation time, and self absorption of radiation with the specimen. Consequently, the determination was not carried out by the generally used reference method for the activation analysis, but by the activity measurement method. (auth)

10011 DETERMINATION OF IRON, COPPER, ZINC AND COBALT IN HIGH PURITY CHROMIUM AND THORIUM NITRATE. CHEMICAL ANALYSIS OF CHROMIUM (II). Nobuhisa Matano and Akira Kawase. Trans. Natl. Res. Inst. Metals (Tokyo), 4: 212-16(1962).

A method for the ion exchange separation and spectrophotometric determination of impurities in Cr and Th nitrates is described. The sample is dissolved in hydrochloric acid, and passed through air to convert chromium (II) to chromium (III), then potassium chlorate is added to complete dissolution of the sample in hydrochloric acid. The solution is passed through the anion exchange column for separation of chromium from iron, copper, zinc, and cobalt. Since an insufficient separation of copper from cobalt and copper from iron is obtained, two columns are used for determination of these elements. Copper and zinc are eluted from the one column with 35 ml of 2.5 N hydrochloric acid and 60 ml of 1 N nitric acid, respectively, and determined with neocuproine and dithizone. The cobalt and iron are eluted from the other column with 35 ml of 4 N hydrochloric acid and 40 ml of 0.5 N hydrochloric acid, respectively, and determined with nitroso-R salt and o-phenanthroline. The method can also be applied to the determination of impurities in thorium nitrate. (P.C.H.)

10012 APPLICATION OF ISOTHERMS OF ION-EXCHANGE EQUILIBRIUM TO PHENOMENA OBSERVED DURING CHROMATOGRAPHY OF THE RARE EARTHS. I. A. Legenchenko (Inst. of General and Inorganic Chemistry, Odessa). Ukr. Khim. Zh., 29: 25-30(1963). (In Russian)

Ion exchange isotherms were used in a theoretical analysis of elution chromotography of rare earths. The theoretical results were in good agreement with those obtained in practice. (R.V.J.)

10013 COMPARATIVE CHARACTERISTICS IN SPECTROPHOTOMETRIC METHODS OF DETERMINING TANTALUM AND NIOBIUM. I. GENERAL CRITERIA AND INORGANIC REAGENTS. A. T. Pilipenko and O. M. Eremenko (Kiev State Univ.). Ukr. Khim. Zh., 29: 532-8 (1963). (In Russian)

Comparative spectrophotometric studies were made of Ta and Nb using inorganic reagents. It is shown that ether extraction is most efficient for Nb determination, while rhodonide in aqueous-acetone media is best for Nb. (R.V.J.)

10014 COMPARATIVE CHARACTERISTICS OF SPECTROPHOTOMETRIC METHOD OF DETERMINING TANTALUM AND NIOBIUM. II. USE OF ORGANIC REAGENTS. A. T. Pilipenko and O. M. Eremenko (Kiev State Univ.). Ukr. Khim. Zh., 29: 538-47(1963). (In Russian)

Absorption spectra for Nb–Ta alloys were studied, and interfering effects of various elements in spectrophotometric determinations were analyzed. It is shown that rhodonide extraction method is best for Nb, while methyl violet is best for Ta. (R.V.J.)

10015 STUDY OF REAGENTS FOR THE COLORIMETRIC DETERMINATION OF TANTALUM. A. K. Babko and M. I. Shtokalo (Inst. of General and Inorganic Chemis-

try, Odessa). Ukr. Khim. Zh., 29: 963-7(1963). (In Russian)

Absorption spectra of 16 metallochromite indicators and their complexes with Ta at pH 1 were studied. Absorption maxima of complexes, reagents, and complexing absorption band shifts were found as well as molar absorption coefficients for the reagents and complexes and their absolute and relative differences. Tantalum complexes are more intensely colored by pyrocatechin violet, phenylfluorone, eriochromocyanine, and hematoxyl compounds. The most effective reagents are: pyrocatechin violet, hemotoxiline, morin, acid chromium dark-blue, and eriochromocyanine. (R.V.J.)

10016 EXTRACTION-PHOTOMETRIC DETERMINATION OF MOLYBDENUM IN THE FORM OF A DIANTIPYRILMETHANE-THIOCYANATE COMPLEX. M. M. Tananaiko and L. A. Blucke (Kiev State Univ.). Ukr. Khim. Zh., 29: 974-8(1963). (In Russian)

Studies of complex formation in molybdenum-diantipyrilmethane-thiocyanate-reducing agent showed that the presence of diantipyrilmethane produces a low-solubility ternary complex that is easily extracted by heavy diluents. Optimum conditions for formation and extraction were found with 0.02 mole diantipyrilmethane, 0.3 mole ammonium thiocyanate, 2N hydrochloric or sulfuric acid and ascorbic acid as reducing agent. The extracted products are stable. Chloroform and dichloroethane proved to be the most efficient extracting agents. Antipyrine, diphenyl guanidine, and triethylamine also are efficient extracting agents. The complex was used for determining Mo in steel. The sensitivity of the method is 10 γ in 10 ml of the extract at $\lambda = 465$ mμ. (R.V.J.)

10017 DETERMINATION OF LOW-LEVEL RADIOACTIVITY IN WATER. PART 4. Werner N. Grune (Georgia Inst. of Tech., Atlanta), Ross B. Hughes, and George W. Gibson. Water Sewage Works, 110: 143-6(Apr. 1963).

The reproducibility of sample preparation and accuracy of counting was examined by a statistical evaluation of gross alpha and beta radioactivity counting results. Results are presented for the deposition of mixed fission products and uranyl acetate solutions on 2-inch diameter stainless steel planchets. Filtration of water samples through millipore membrane filters, wet and dry ashing of polystyrene based ion exchange resins, and elution as a rapid radioassay method are briefly discussed. (Public Health Eng. Abstr., 43: No. 1-2, 1964)

10018 ENVIRONMENTAL RADIONUCLIDES IN A WATER SUPPLY. E. F. Gloyna (Univ. of Texas, Austin) and W. A. Felsing. Water Sewage Works, 110: 245-50 (July 1963).

The levels of radium-226, strontium-90, and gross beta activity in a municipal water supply and their removal by the use of ferrous sulfate-excess lime coagulation were investigated at the Filtration Plant in Austin, Texas. Radiochemical analyses of untreated, settled, and filtered water samples were performed. Limited samples of sludge from the water treatment plant and scale deposits from the water distribution system were investigated for the activity of radium-226 and strontium-90. (Public Health Eng. Abstr., 43: No. 1-2, 1964)

10019 LECTURES BY THE JOINT WORK SESSION OF THE ANALYTICAL CHEMISTRY PROFESSIONAL GROUP, THE GERMAN COMMITTEE FOR SPECTROCHEMISTRY, AND THE MASS SPECTROSCOPY WORK GROUP IN ASSOCIATION WITH THE GERMAN PHYSICAL SOCIETY, APRIL 24 TO 27, 1963, IN ERLANGEN. 3. EMISSION SPECTRAL ANALYSIS ON THE QUANTITATIVE SPECTROSCOPIC ANALYSIS OF PLASMA. W. Lochte-Holtgreven (Universität, Kiel). Z. Anal. Chem., 198: 1-9(1963). (In German)

In case excitation conditions of a plasma are changed, absolute intensities of spectral lines were found not to be sufficient to evaluate quantitatively the composition of the plasma. In these cases additional information can be obtained from line widths. In two examples it is shown how quantitative analysis of a plasma is made possible, using line widths. (auth)

10020 QUANTITATIVE SPECTROCHEMICAL INVESTIGATIONS WITH HIGH-FREQUENCY PLASMA FLAMES. W. Tappe and J. van Calker (Universität, Munster, Ger.). Z. Anal. Chem., 198: 13-20(1963). (In German)

For production of high-frequency plasma flames, generators of various types are used for the frequencies 27.1, 461, and 2,400 Mcps. The high-frequency plasma flame is suitable for the excitation of materials, which get into the flame as small fluid particles. The background essentially consists of lines and bands of the working gas and the solvent. The intensity of a spectral line has a fluctuation of about 3 to 4%. The sensitivity limit for a list of elements is reported. Elements with a low ionization potential produce notable interactions in the plasma, while elements with high ionization potential show no interferences. With air as the working gas, measurements of temperature gave values of 3,000 to 4,000°K, according to the height in the flame. (auth)

10021 THE INFLUENCE OF GAS-VAPOR COMPOSITIONS ON THE LINE INTENSITIES OF SPECTROCHEMICAL PLASMA (3000-50,000°K). Hand Krempl (Technische Hochschule, Munich). Z. Anal. Chem., 198: 21-7(1963). (In German)

Not all "third partner" influences in spectrochemical analysis are declared by the mechanism of evaporation of electrode-plasma. In the plasma itself the electron pressure, which is the result of the combination of all partners in the gas-vapor mixture, determines the ionization and excitation. For a number of elements the electron pressure was calculated with temperature and the influence of mixtures estimated. In the arc region, 3,000 to 10,000°K, a strong "third partner" influence on the plasma could be observed, while in the spark region, 10,000 to 50,000°K, this influence could be neglected. (auth)

10022 DETERMINATION OF OXYGEN, HYDROGEN, AND NITROGEN IN TUNGSTEN, NIOBIUM, AND TANTALUM. Yu. A. Klyachenko, T. A. Izmanova, and E. M. Chistyakova (Central Research Inst. of Ferrous Metallurgy, Academy of Sciences, USSR). Zavodsk. Lab., 29: 1425-7 (1963). (In Russian)

A method is suggested for determining gas content in W, Nb, and Ta. A cobalt vat is recommended for melting Ta and a Ni vat for Nb and W. (R.V.J.)

10023 ALKALI-OXIDATION DISSOLUTION OF NIOBIUM, TANTALUM, AND THEIR ALLOYS DURING ANALYSIS FOR NITROGEN. B. Ya. Kaplan and G. N. Revyakina (State Research Inst. of Rare Metals, Academy of Sciences, USSR). Zavodsk. Lab., 29: 1427-8(1963). (In Russian)

Alkali oxidizers were used in the determination of nitrogen in Nb, Ta, and their alloys. The method combines dissolved metals with ammonia followed by separation. The sensitivity of the method is 0.003% nitrogen in 0.1-g specimens. The process requires 1 to 1.5 hrs. (R.V.J.)

10024 NUCLEAR ACTIVATION ANALYSIS. Edgar L. Steele (Texas Agricultural and Mechanical Coll., College Station). p.315-55 of "Proceedings of the Symposium on Physics and Nondestructive Testing." San Antonio, Texas, Southwest Research Institute, 1963.

The principles of activation analysis, the nuclear reactions involved, and techniques used are discussed. Radiation sources suitable for activation analyses are described. Experimental results are presented for thermal-neutron activation analyses for tellurium, dysprosium, arsenic, and barium in biological samples, and for fast-neutron analyses for oxygen, barium, and bromine. 26 references. (R.E.U.)

10025 MASS SPECTROMETRY OF ORGANIC IONS. F. W. McLafferty, ed. New York, Academic Press, 1963. 740p.

Information is included on: quasi-equilibrium theory of mass spectra; ion-molecule reactions; appearance potential data of organic molecules; negative ion mass spectra; mass spectrometry of organic radicals; mass spectrometry of ions from electric discharges, flames, and other sources; decompositions and rearrangements of organic ions; high resolution mass spectrometry; mass spectrometry of long-chain esters; mass spectra of alkylbenzenes; applications to natural products and other problems in organic chemistry; molecular structure of petroleum; and mass spectra of terpenes. (P.C.H.)

10026 A MASS SPECTROMETER FOR THE DETERMINATION OF RELATIVE ABUNDANCES OF Li ISOTOPES IN SOLIDS. K. Kraeutle. Thesis, Munich, Universität, 1962. 149p. $2.00 (Gmelin, AED-DISS. 62-611).

Methods for the measurement of the natural isotopic abundance of Li are discussed. The construction of a mass spectrometer for the analysis of solids is described. The influence of mass dependence of the evaporation, focusing of the ions, and secondary effects in the collector on accuracy and reproducibility are discussed in detail. An equation for the vapor pressure of LiCl for pressures between 10^{-10} and 10^{-6} mm Hg is given. The accuracy for abundance measurements of LiCl is 0.2%. With this method an isotopic ratio for Li of 12.41 was obtained. (Gmelin Inst.)

10027 RADIONUCLIDE ANALYSIS OF ENVIRONMENTAL SAMPLES. Paul F. Hallbach, ed. The Robert A. Taft Sanitary Engineering Center Technical Report R59-6. Cincinnati, Robert A. Taft Sanitary Engineering Center, 1959.

Analytical methods developed for determining radioisotopes in environmental samples are summarized. Information is included on: instrumentation; gross radioactivity, isotopic analyses (radiochemical procedures); and special procedures applicable to specific sample types. (P.C.H.)

10028 ANALYSIS OF VANADIUM IN MILK POWDER BY NEUTRON ACTIVATION ANALYSIS USING A RAPID RADIOCHEMICAL SEPARATION OF 3.77-MINUTE VANADIUM-52. V. J. Molinski (Oak Ridge Gaseous Diffusion Plant, Tenn.), Werner H. Wahl, and William H. Strain. 4p. (CONF-187-40)

From American Nuclear Society Meeting, New York, Nov. 1963.

A procedure is described for the activation determination of V in powdered milk using 3.77-min V^{52}. The quantity of V in the sample is obtained by comparing the V^{52} radioactivity found in the test sample with the V^{52} radioactivity in a V comparator sample that is treated in the same manner as the test sample. The procedure can also be used for the determination of V in a variety of materials. (P.C.H.)

10029 NEUTRON ACTIVATION ANALYSIS OF ARSENIC IN HUMAN HAIRS AND FINGER NAILS. H. Gómez and G. B. Baró (Atomic Energy Commission, Argentina). 6p. (CONF-313-6)

From 2nd National Meeting of the Society for Applied Spectroscopy, San Diego, Calif., Oct. 1963.

A method is described for the determination of arsenic in human hair and finger nails by neutron activation. Measurements were carried out with a scintillation assembly and a multichannel analyzer. Data are tabulated. (P.C.H.)

10030 X-RAY FLUORESCENT ANALYSIS APPARATUS COMPRISING A CONSTANT AVERAGE CHANNEL HEIGHT PULSE ANALYZER. Sjoerd Wytzes and Louis L. A. Augustus (to North American Philips Co., Inc.). U. S. Patent 3,119,013. Jan. 21, 1964. Priority date Jan. 29, 1960, Netherlands.

A device is described for analyzing the secondary radiation of an object in an x-ray beam, comprising an x-ray spectrometer, an amplitude filter with constant average channel height for pulses, a rotatable analyzing crystal and radiation dectector, and a potentiometer with movable contact that is coupled to the analyzing crystal. (R.E.U.)

Inorganic and Physical Chemistry

10031 (AD-403803) HYDROGEN TRACER STUDIES ON THE REACTIONS OF URANIUM HYDRIDE WITH AQUEOUS OXIDIZING AGENTS. Final Report, Part I. John B. Hunt and Henry Taube (Chicago. Univ.). Contract Nonr-2121(16). Dec. 14, 1962. 24p.

A detailed investigation of the isotopic course of the reactions of uranium hydride with acids is described. The study was extended to include other oxidizing agents as well. Stoichiometry is a matter of considerable interest because all of the reagents used have the capacity to oxidize hydrogen; thus, it is of interest to learn to what extent hydrogen is evolved by their action. Preliminary results for CeH_3 and TiH_2 which are of interest for comparison purposes are also described. (auth)

10032 (AD-410431) WAVE FUNCTIONS, ENERGIES, AND REDUCED MATRIX ELEMENTS OF THE $5f^3$ CONFIGURATION IN INTERMEDIATE COUPLING. Technical Report No. AF-105. Hannah M. Crosswhite (Johns Hopkins Univ., Baltimore. Carlyle Barton Lab.). May 1963. Contract AF33(756)-11029. 30p.

Since the crystal field can be considered as a perturbation of the free ion spectra of actinide ions in certain crystals, energy levels and wave functions of the 5f(3) configuration, which is the ground configuration of U^{3+}, were calculated in intermediate coupling for values of χ = zeta/F2 of 7 to 11. Energy levels are given in units of F2, and wave functions are expressed as linear combinations of Russell-Saunders functions. Hydrogenic and non-hydrogenic approximations are compared. Reduced matrix elements in intermediate coupling are given so that crystal field splittings may be calculated. The splittings of the two lowest levels of U^{3+} in a weak field with and without J-mixing are compared. (auth)

10033 (CONF-117-39) THE UNSTABLE SPECIES AND THE ISOTOPE EFFECT IN THE PYROLYSIS OF DIBORANE IN A SHOCK TUBE. T. P. Fehlner and W. S. Koski (Johns Hopkins Univ., Baltimore). [1963]. Contract [AT (30-1)-1447]. 37p.

From American Chemical Society 145th National Meeting, New York, Sept. 1963.

The pyrolysis of diborane was examined using a chemical shock tube as a reactor. Additional evidence for the existence of hexaborane-12 and heptaborane-11 and -13 was obtained. The presence of a large net normal isotope effect in the formation of tetraborane and hexaborane and a net inverse isotope effect in the formation of pentaborane-9 are observed. A mechanism, consisting of a series of competitive reactions and equilibria, in which tetraborane is the precursor of pentaborane-11 and hexaborane but not of pentaborane-9 is shown to be compatible with the observed isotope effect. Data obtained by examining the pyrolysis of various mixtures of boron hydrides are also consistent with the mechanism. (auth)

10034 (CONF-303-15) THE MÖSSBAUER EFFECT IN XENON COMPOUNDS. G. J. Perlow and M. R. Perlow (Argonne National Lab., Ill.). [1963]. Contract [W-31-109-eng-38]. 16p.

From 3rd International Conference on the Mössbauer Effect, Ithaca, N. Y., Sept. 1963.

Studies were made of the structure of Xe compounds using the Mössbauer effect. In the first experiments, XeF_2, XeF_4, hydroquinone–Xe clathrate, and a perxenate of nominal composition $Na_4XeO_6 \cdot nH_2O$ were used as absorbers, with NaI^{129} as the source. No isomer shift outside the experimental error was observed; the clathrate and xenate show single lines while the fluorides show quite large quadrupole splitting. Similar experiments using $Xe^{131}F_4$ and NaI^{131} as absorber and source, respectively, showed no absorption dips. Next, several I^{129} sources (I_2, NaI, $NaIO_3$, and $Na_3H_2IO_6$) were studied with Xe clathrate as absorber; the line width was found to be the same for all sources. The results are interpreted in terms of XeO_3^- and XeO_4^- ions. (D.L.C.)

10035 (CONF-387-1) AN APPROACH TO THE STUDY OF ELECTROLYTE BEHAVIOR IN CONCENTRATED SOLUTIONS. Leslie Leifer (Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry and Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science) and Erik Hoegfeldt (Sweden. Kungliga Tekniska Högskolan, Stockholm). [Feb. 3, 1964]. Contract AT(30-1)-905. 12p.

From 1st Australian Conference on Electrochemistry, Sydney, Feb. 1963.

A study was made of the interactions in concentrated electrolyte solutions. Combination of Hammett acidity and activity data allowed the determination of ion activity and ion activity coefficient functions for the ions in several divalent metal perchlorate–water systems as well as in hydrochloric acid–water mixtures. The fact that a unique ion activity function was obtained for H_3O^+ in several strong acids enabled the calculation of at least approximate values for ionic hydration as a function of composition. Further, the results indicate the marked stability of $H_9O_4^+$ in concentrated HCl solutions and a likely mechanism for the acid dissociation. (auth)

10036 (DRI-2139) A STUDY OF THE SYNTHESIS AND PROPERTIES OF TRANSITION METAL HYDRYLS. Sixth Quarterly Progress Report, October 1, 1963 through December 31, 1963. Charles B. Magee (Denver. Univ. Denver Research Inst.). Jan. 15, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1185. 19p. (EURAEC-939)

An experiment has been completed in which hydrogen gas was added to the intermediate phase LiRh at 700°C. The equilibrium pressure versus gram-atom fraction hydrogen in the condensed phase, N_H, curve shows two plateaus indicating two areas in the ternary phase diagram where four phases are in equilibrium. The nature of these phases has not as yet been determined. X-ray-diffraction analysis of the material resulting from this experiment showed it to be predominantly $Rh_2(LiH)_5$. Hydrogen has been added to a 4 to 1 molar ratio mixture of Li and Ir at 800°C. The equilibrium pressure isotherm is quite different in shape from that of the Li–Rh–H system at the same temperature. There is a suggestion of a plateau for the Li–Ir–H system where none was observed for the Li–Rh–H system. The stoichiometry of the material resulting from this experiment is that of $Ir(LiH)_4H$. An attempt is being made to index the x-ray-diffraction pattern of this material. The indications are, so far, that the lithium iridium hydryls are more stable than the lithium rhodium hydryls. The intermediate phase LiIr was prepared, and some of its properties were determined. The crystal structure of this compound is the same as that of LiRh, that is, hexagonal close-packed with alternate layers of lithium and rhodium (or iridium). The theoretical density of LiIr is 12.7 g/cc. The measured density (of one sample) is 11.44 g/cc. Attempts to prepare LiCo, which have so far been unsuccessful, are continuing. Solution calorimetry is being used to determine the heats of formation of LiRh, LiIr, and the hydryls. The elements and the compounds are separately dissolved in liquid tin and the heats of formation calculated from the heats of solution. Tentative results obtained so far for the heats of solution of Li and Rh in liquid tin at 750°K are, for Li: $-11,100 \pm 230$ cal/mole; and for Rh: $-26,440 \pm 430$ cal/mole. (auth)

10037 (EUR-345.e) GROWTH OF UO_2 SINGLE CRYSTALS. S. Amelinckx, J. Bressers, K. Nevelsteen, E. Smets, and W. Van Lierde (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). 1963. 31p.

A new method for growing uranium dioxide single crystals from the vapor is described. A cylinder of pressed and sintered UO_2 powder is pressed between two cooled electrodes and heated by an electric current directly passing through it. UO_2 vaporizes from the inside of the cylinder to the cold end-plates of the electrodes, where deposits are formed consisting of a few large single crystals. Crystals from 4 to 12 mm in size and up to 5 g in weight are easily obtained. Control by Laue diffraction patterns and chemical analysis showed these crystals to be of high perfection and purity. The preparation of UO_2 single crystals from a molten solution of UO_2Cl_2 is also described. (auth)

10038 (HW-79354) REDUCTION OF PLUTONIUM(VI) TO PLUTONIUM(III) AND (IV) BY SODIUM NITRITE. C. A. Colvin (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 28, 1963. Contract AT(45-1)-1350. 7p.

The use of anion exchange for final Pu purification in the Redox facility requires the adjustment of Pu(VI) to Pu(IV). Two methods of reduction were investigated: ferrous sulfamate and nitrite. The ferrous sulfamate method was adopted. Data on reduction of Pu(VI) to Pu(IV) and Pu(III) by nitrite are presented. The reduction by nitrite was found to be dependent on nitrite concentration, temperature, acidity, ferric ion concentration, and time, and it is possible to obtain >90% reduction to Pu(III) by controlling the above conditions. (D.L.C.)

10039 (IS-739) SPECTROPHOTOMETRIC STUDY OF THE GASEOUS EQUILIBRIUM OF CADMIUM AND CAD-

MIUM(II) CHLORIDE. Buddy L. Bruner and J. D. Corbett (Ames Lab., Ames, Iowa). Nov. 1963. Contract W-7405-eng-52. 82p.

A Beckman DU spectrophotometer was modified to permit investigation of high temperature gaseous equilibria. The Cd–$CdCl_2$ system was studied in an effort to characterize the nature of the equilibrium species and to evaluate the thermodynamic functions describing their interaction. Gas phase absorption spectra were taken of cadmium metal, cadmium(II) chloride, and their mixtures, both as all gaseous systems and over the condensed phases. The mixed systems displayed a series of bands in addition to the characteristic metal and dichloride transitions. The new systems were headed by doublet transitions at 3070 and 3170 Å and were found to correspond to the monohalide, CdCl. No other species were detectable. Quantitative studies of three gaseous mixtures of varying compositions were analyzed over the temperature range from 660 to 780°. These data yielded a value of 34.15 ± 0.5 kcal/mole for ΔH°_{1000} of the reaction, $CdCl_2(g) + Cd(g) = 2CdCl(g)$. A value of 23.58 kcal/mole was computed for ΔF°_{1000} using the measured heat and the third law entropy. A similar analysis of the 3178 Å transition displayed by the metal vapor produced a value of 1.67 ± 0.2 kcal/mole for heat of dissociation of Cd_2 at 1000°K. Experimental and estimated values of the heat of the reaction, $MX_2(g) + M(g) = 2MX(g)$, for the group IIb metals and their metal halides were tabulated. Values of 84.43 kcal/mole for the heat of the reaction, Cd_2Cl_2 (dissolved in $CdCl_2$) = 2CdCl(g) at 1000°, and 49.86 kcal/mole (2.17 ev) at 298.15°K for the heat of dissociation of CdCl were also calculated. The vibrational bands of CdCl were tabulated and analyzed as a $^2\pi_{1/2}-{}^2\Sigma$ system. The 3181 Å line was not observed and its previous assignment to this system is concluded to be erroneous. The observed vibrational transitions were fit to a Deslandres table and yielded apparent values of 334.5 cm^{-1} for ω''_e, 1.25 cm^{-1} for $x''_e\omega''_e$ of the $^2\Sigma$ ground state, and 397.1 cm^{-1} for ω'_e and 0.92 cm^{-1} for $x'_e\omega'_e$ of the $^2\pi_{1/2}$ excited state. The vibrational constants were noted to differ from those previously reported in the literature. (auth)

10040 (MIT-1965-3) ON THE QUESTION OF THE HEXACHLORORHENATE(III) ION. F. A. Cotton and B. F. G. Johnson (Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry). Jan. 31, 1964. Contract AT(30-1)-1965. 9p.

A claim in the Russian literature in 1954 that salts of the hexachlororhenate(III) anion can be prepared by reduction of rhenate in concentrated hydrochloric acid with hydrogen at elevated temperatures and pressures, is shown to be erroneous. All of the materials reported contain hexachlororhenate(IV). (auth)

10041 (ORNL-TM-747) THERMAL, RADIATION AND CHEMICAL STABILITY OF SULFUR DIOXIDE. R. L. Bennett and G. W. Keilholtz (Oak Ridge National Lab., Tenn.). Dec. 31, 1963. Contract W-7405-eng-26. 7p.

A search for information on the thermal, radiation, and chemical stability of sulfur dioxide was made. Although sulfur dioxide has a very high thermal stability it is very reactive with carbon, especially at temperatures above 500 to 800°C. The radiation stability is not promising. (D.L.C.)

10042 (TID-7675) PROCEEDINGS OF THE PROTACTINIUM CHEMISTRY SYMPOSIUM, GATLINBURG, TENNESSEE, APRIL 25-26, 1963. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. 180p.

Eleven papers are presented on the chemistry of protactinium. Most of the emphasis is on solvent extraction and solution chemistry. Separate abstracts were prepared for ten of the papers; the remaining paper was previously abstracted in NSA. (D.L.C.)

For abstracts of individual papers see: 9962, 10043, 10044, 10045, 10046, 10047, 10048, 10049, 10050, and 10183.

10043 (TID-7675(p.1-15)) PROTACTINIUM SPECIES IN TBP–NITRIC ACID SYSTEMS. C. J. Hardy and D. Scargill (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The species of Pa in HNO_3 and TBP phases were studied by extraction of aqueous solutions with TBP in kerosene or xylene at varying Pa and HNO_3 concentrations, volume ratios, and temperature, and by paper chromatography of TBP phases with methylisobutylketone and TBP–kerosene as elutants. The results in aqueous HNO_3 are explained in terms of rapid equilibria between monomers which are in slow equilibrium with inextractable polymers. Some of the polymers can be depolymerized and then extracted by dilution at constant HNO_3 concentration. At low acidities, the degree of aggregation increases considerably with resultant settling. At least two Pa species are extracted by TBP from a Pa solution in 6 M HNO_3. (D.L.C.)

10044 (TID-7675(p.35-45)) PROTACTINIUM STABILITY IN THORIUM NITRATE–NITRIC ACID SOLUTIONS. C. J. Barton, D. R. Cuneo, M. J. Kelly, and J. E. Strain (Oak Ridge National Lab., Tenn.).

An exploratory study was carried out on the hydrolytic behavior and stability of Pa in $Th(NO_3)_4$–HNO_3 solutions at high temperatures up to >200°C. The results indicate that 10 to 100 ppm Pa is sufficiently stable in solutions containing up to 2.5 M $Th(NO_3)_4$ and as little as 0.2 M HNO_3 at temperatures <180°C for the solutions to be used as breeder blankets in homogeneous reactors. (D.L.C.)

10045 (TID-7675(p.57-71)) PROTACTINIUM FLUORIDES. Lawrence Stein (Argonne National Lab., Ill.).

The following reactions have been studied with 5 to 200 mg amounts of Pa^{231}; most products have been identified by x-ray powder patterns and chemical or radiochemical analyses:

$$Pa_2O_5\,(s) + 8HF\,(g) + H_2\,(g) \xrightarrow{500^\circ} 2PaF_4\,(s) + 5H_2O\,(g)$$

$$PaF_4\,(s) + \tfrac{1}{2}F_2\,(g) \xrightarrow{700^\circ} PaF_5\,(s)$$

$$2PaF_4\,(s) + \tfrac{1}{2}O_2\,(g) \xrightarrow[600^\circ]{F_2} Pa_2OF_8\,(s)$$

$$Pa_2O_5\,(s) + 4F_2\,(g) \xrightarrow{550^\circ} Pa_2OF_8\,(s) + 2O_2\,(g)$$

$$Pa_2O_5\,(s) + 8HF\,(g) \xrightarrow[500^\circ]{O_2} Pa_2OF_8\,(s) + 4H_2O\,(g)$$

$$Pa_2OF_8\,(s) \xrightarrow{800^\circ} PaF_5\,(s) + \text{unidentified solid}$$

$$Pa_2O_5\,(s) + [HF,H_2O](aq) \xrightarrow{25^\circ} \text{Solution} \xrightarrow{110^\circ} 2PaF_5\cdot 2H_2O\,(s)$$

$$2PaF_5\cdot 2H_2O\,(s) \xrightarrow{160^\circ} Pa_2OF_8\,(s) + 2HF\,(g) + H_2O\,(g)$$

Protactinium tetrafluoride is obtained as dark brown, monoclinic, needlelike crystals on heating Pa_2O_5 in a mixture of HF and H_2. It is non-volatile in vacuum up to 800°C and is virtually insoluble in water and mineral acids, even in the presence of oxidizing agents and fluoride complexing agents. When the tetrafluoride is heated with purified fluorine, it is converted to the pentafluoride, which is a white solid isomorphous with the β form of UF_5 (tetragonal crystal structure). The pentafluoride is less volatile than its homologues VF_5, NbF_5, and TaF_5, but can be distilled in vacuum above 500°. It is slightly soluble in water and very soluble in aqueous hydrofluoric acid. When protactinium

tetrafluoride is heated with fluorine containing oxygen impurity, an oxyfluoride is obtained which appears to have the composition Pa_2OF_8. This is a white solid, slightly volatile in vacuum above 500°, isomorphous with U_2F_9 (body-centered cubic structure). The same product is obtained when protactinium pentoxide is heated with fluorine or with a mixture of hydrogen fluoride and oxygen. At approximately 800°, the oxyfluoride partly decomposes to PaF_5 and other unidentified solids. When protactinium pentoxide is dissolved in aqueous hydrofluoric acid and the solution is evaporated to dryness at 110, colorless needlelike crystals of the approximate composition $PaF_5 \cdot 2H_2O$ are obtained. The crystals decompose on further heating at 160°, yielding Pa_2OF_8. (auth)

10046 (TID-7675(p.72-85)) CHARACTERIZATION OF PROTACTINIUM SPECIES IN CRYSTALS AND SOLUTIONS BY RAMAN AND INFRARED SPECTROSCOPY. O. L. Keller, Jr. (Oak Ridge National Lab., Tenn.).

Species in solutions can be identified by comparing the Raman spectra of the solutions with those of crystals of known composition and structure. This technique is illustrated using niobium fluoride species, and the adaptation of the technique to protactinium is discussed. A compound presumed to be K_2PaF_7 was prepared by dissolving Pa_2O_5 in HF, but its Raman spectrum was different from that of K_2NbF_7; the broad peak suggests a hydrolytic polymeric species. Another attempt was made to prepare K_2PaF_7 by dissolving Pa in H_2SO_4 and recrystallizing from HF, but the results indicate that a mixture of K_2PaF_7 and $KPaF_6$ was obtained. Further work has to be done to prepare a pure Pa compound. It is pointed out that the dominant species in one phase is not necessarily the extracted species in another phase and therefore Raman spectra of both phases must be taken. (D.L.C.)

10047 (TID-7675(p.87-104)) THE CHEMISTRY OF PROTACTINIUM IN SULFURIC ACID SOLUTIONS. D. O. Campbell (Oak Ridge National Lab., Tenn.).

Results are presented of preliminary studies of the H_2SO_4–Pa system. Difficulties of Pa assay are described briefly. Data are given on the solubility of Pa_2O_5 in H_2SO_4 as a function of H_2SO_4 concentration. Most of the studies were done on amine extraction and ion exchange (Dowex 1) experiments, and the effects of amine concentration and type, acid concentration, etc. on the extraction and ion exchange were determined. Possible mechanisms for the extraction processes are suggested. (D.L.C.)

10048 (TID-7675(p.105-21)) IONIC SPECIES OF PROTACTINIUM IN HYDROCHLORIC ACID. Hans-Ludwig Scherff and Guenter Herrmann (Mainz. Universität. Institut für Anorganische Chemie und Kernchemie).

The solvent extraction of Pa from HCl solutions by diisobutylcarbinol was investigated and the partition data used to evaluate the Pa species. The species were found to range from $Pa(OH)_5^{2+}$ and $Pa(OH)_4^{+}$ at 2 M HCl to $PaCl_7^{2-}$ at 8 M HCl. (D.L.C.)

10049 (TID-7675(p.157-9)) OBSERVATIONS ON THE BEHAVIOR OF PROTACTINIUM IN HCl–HF SOLUTIONS. J. M. Chilton (Oak Ridge National Lab., Tenn.).

In the irradiation and processing of Pa_2O_5 for the production of pure U^{232}, a number of qualitative and semiquantitative observations were made on the behavior of Pa in HCl–HF solutions. These observations include the solubilities of Pa_2O_5 in HCl, ammoniacal solutions, and HCl–HF solutions; the effects of $AlCl_3$ on the Pa loading on Dowex-1X8 anion exchange resin from HCl–HF solutions; and the effects of $AlCl_3$ on the solvent extraction of Pa from HCl–HF solutions by di(2-ethylhexyl)phosphoric acid in diethylbenzene. (D.L.C.)

10050 (TID-7675(p.160-8)) THE CHEMISTRY OF PROTACTINIUM. G. Bouissieres, M. C. Ferradini, M. Garcon, R. Guillaumont, M. Hussonois, R. Muxart, H. Pezerat, D. Robertson, and T. Stchouzkoy (Paris. Universite. Institut du Radium. [Laboratoire Curie]).

Studies were made of the chemical properties of Pa in its two oxidation states and the nuclear reactions in which Pa is either the target or the formed element. The solvent extraction of Pa from aqueous solutions by tri-n-octylamine and TTA was studied. The precipitation of Pa peroxide was also studied. The preparation of metallic Pa is considered briefly. Yields are given of the reactions U(p,2pxn) for U^{235} and U^{238} as a function of proton energy. (D.L.C.)

10051 (UCRL-11097) FRACTIONAL RELEASE OF A TRACER ELEMENT THROUGH A MOVING BOUNDARY (thesis). Stephen D. Lowe (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 30, 1963. Contract W-7405-eng-48. 100p.

A full solution for the fractional release of a tracer element through a moving boundary has been obtained for the cases of a slab and a sphere. In both cases, the initial distribution of the tracer is assumed to be uniform throughout the body. For a constant rate of boundary motion, the full solution is valid for all times over the range from zero to complete evaporation of the body, and this solution may be applied to all finite rates of boundary motion. By applying certain limitations to the time range and to the total amount of boundary motion, the full solutions are reduced to approximate forms that are presented graphically as a family of curves. For a more limited range of application, i.e., for small values of the quantity $\frac{1}{2}(ba/D)(Dt/a^2)^{\frac{1}{2}}$ (<0.2), where b is the rate of boundary motion, t is the time, D is the diffusion constant, and a is a characteristic dimension of the body (half-width for the slab and radius for the sphere), simplified expressions are developed for the fractional release of the tracer, f, which may be used to more accurately determine the diffusion coefficient, D. These simplified expressions are $f = (2/\pi^{\frac{1}{2}})(Dt/a^2)^{\frac{1}{2}} + (\frac{1}{2})(bt/a)$ for the slab, and $f = (6/\pi^{\frac{1}{2}})(Dt/a^2)^{\frac{1}{2}} + (\frac{3}{2})(bt/a)$ for the sphere. (auth)

10052 (EURAEC-761) APPLICATION OF TRANSIENT ELECTROCHEMICAL METHODS TO THE CHEMICAL ANALYSIS OF PRODUCTS USED IN ATOMIC CHEMISTRY. Quarterly Report No. 11, Jan. 1, 1963–June 30, 1963. (Brussels. Université). Work Performed under United States–Euratom Joint Research and Development Program. Contract 018-60-7 RDB. 19p. (A translation)

The study of the dismutation kinetics of U^V in a carbonate medium was completed by the determination of its free activation energy (E = 21.5 kcal/mole). The range of very high velocities was investigated by polarography (measurement of the i_l/i_d ratio). This range is not very accessible and seems to involve a modification of the mechanism, accompanied by a reduction of velocity. A bibliographical study of carbonated complexes of uranium was made. The precipitation equilibria of the U^{VI} and U^V carbonated forms with very high pH values were investigated. The oxidation wave of U^{IV} in a bicarbonated medium (influence of the ionic force of a tensioactive anion such as SCN^-) was studied. A study of the U^{VI}/U^V couple in a NaOH medium was made. This has led to the discovery that a new particle is being released. This particle, though unstable, can be studied experimentally thanks to its slow precipitation equilibrium which is retarded still more by the addition of carbonate. (auth)

10053 THE CRYSTAL STRUCTURE OF CAESIUM URANYL OXYCHLORIDE $Cs_x(UO_2)OCl_x$ (X APPROXIMATELY 0.9). J. G. Allpress and A. D. Wadsley (Commonwealth Scientific and Industrial Research Organization, Melbourne). Acta Cryst., 17: 41-6(Jan. 10, 1964).

Cesium uranyl oxychloride, $Cs_x(UO_2)OCl_x$ (x approximately 0.9), crystallizes in the space group $P2_1/m$ with two formula units in the cell of dimensions a = 8.734, b = 4.118, c = 7.718 Å; β = 105°16'. The crystal structure, determined by Fourier methods, was refined by least-squares techniques with the occupancies x for Cs and Cl included as additional variables. Uranium is in sevenfold coordination, a pentagonal bipyramid, with five oxygen and two chlorine ligands. Bipyramids join up by having edges in common forming infinite two-dimensional strings from which the uranyl oxygens (the apices of the bipyramids) protrude. The cesium ions, in eightfold coordination with atoms from the strings, bind the structure together. (auth)

10054 HYPERFINE STRUCTURE OF THE 14.4 kev GAMMA LINE OF ^{57}Fe IN SOME IRON OXY-HYDROXIDES INVESTIGATED WITH THE MÖSSBAUER EFFECT. A. Z. Hrynkiewicz and D. S. Kulgawczuk (Inst. of Nuclear Physics, Polish Academy of Sciences, Krakow and Jagiellonian Univ., Krakow). Acta Phys. Polon., 24: 689-92(Nov. 1963).

The hyperfine structure of the 14.4-kev gamma line of Fe^{57} in lepidocrocite (γ-FeOOH) and geothite (α-FeOOH) was studied. In lepidocrocite only the quadrupole splitting $\Delta E = (0.45 \pm 0.05)$ mm/sec is observed. In geothite, besides the quadrupole splitting $\Delta E = (0.24 \pm 0.05)$ mm/sec, two values of the magnetic field intensity at iron nuclei $H_1 = (282 \pm 5)$ kOe and $H_2 = (342 \pm 7)$ kOe are found. This indicates the existence of two sublattices in α-FeOOH. (auth)

10055 MICROSCOPICAL IDENTIFICATION OF THE CERIUM GROUP RARE EARTH ELEMENTS. Fredric D. Leipziger, William J. Croft, and John E. Roberts (Sperry Rand Research Center, Sudbury, Mass.). Anal. Chem., 36: 314-15(Feb. 1964).

The addition of a mixture of formic acid and ammonium formate to a cerium group rare earth solution produces a characteristic precipitate. The rare earth elements from lanthanum to gadolinium produce a complex series of crystalline formates that eventually become spherulitic. The habit of these compounds is sufficiently unique to enable their use as a microscopical method of identification. (auth)

10056 A THERMOGRAVIMETRIC STUDY OF THE SELENITES OF HAFNIUM AND ZIRCONIUM. R. W. Adams and H. Holness (Univ. of Manchester, Eng.). Analyst, 89: 31-5(Jan. 1964).

A study of the thermal decomposition of zirconium selenite and hafnium selenite was made, with the use of a Stanton recording thermobalance, to assess the usefulness of the compounds for determining the two metals in admixture. The results show that the use of the compounds is to be recommended, provided that care is taken to ensure the complete conversion of the basic selenite to the normal selenite. (auth)

10057 ANNUAL REVIEW OF PHYSICAL CHEMISTRY. VOLUME 14. H. Eyring, C. J. Christensen, and H. S. Johnston, eds. Annual Reviews, Inc., Palo Alto, Calif., 1963. 433p.

Sixteen articles are included; separate abstracts were prepared for 4. The 12 articles not abstracted in NSA include information on fast reactions in solution; electronic spectra of molecular crystals; lattice dynamics; statistical mechanics; solutions of electrolytes; heterogeneous catalysis; kinetics of solids; solutions of nonelectrolytes, thermodynamics of solutions at low temperatures; nucleophilic reactivity, high polymers, and infrared vibrational-rotational spectroscopy. (P.C.H.)

For abstracts of individual papers see: 10058, 10143, 11106, and 11225.

10058 CHEMICAL RESEARCH WITH MOLECULAR BEAMS. Wade L. Fite (General Atomic Div., General Dynamics Corp., San Diego, Calif.) and Sheldon Datz. Ann. Rev. Phys. Chem., 14: 61-88(1963).

The general applications of molecular beams in chemistry, gas-gas collisions, and gas-surface interactions are reviewed. 108 references are included. (P.C.H.)

10059 MELTING DIAGRAM OF THE SYSTEM $CaO-Al_2O_3-ZrO_2$. A. S. Berezhnoi (Inst. of Refractory Materials, Academy of Sciences, Ukrainian SSR) and R. A. Kordyuk. Dopovidi Akad. Nauk Ukr. RSR, No. 10, 1344-9 (1963). (In Ukrainian)

Coexistent phases in the system $CaO-Al_2O_3-ZrO_2$ were determined. A new compound $Ca_7Al_6ZrO_{18}$ was found with the properties: density 3.10 g/cm^3, melting point 1550°C, coefficient of thermal expansion $8.7 \cdot 10^{-6}$. $N_g = 1.710$; $N_m = 1.707$; $N_p = 1.705$; 2 V = 53.1°; it is biaxial positive, formed from oxides in the solid phase with increase in volume approximately by 24% through binary compounds ($CaZrO_3$ and $CaAl_2O_4$); it reacts with water. The x-ray characteristics of the compound are given. The melting diagram of the system $CaO-Al_2O_3-ZrO_2$ was established and the areas containing not more than 10% of the melt at 1600°C, were found on its basis by calculation. The system is characterized by near location of the melting curve of 1600°C to $CaZrO_3$ and even to ZrO_2, which prevents the use of its ternary compounds in refractory technology. (auth)

10060 PREPARATION OF URANIUM DIOXIDE BY ELECTROCHEMICAL REDUCTION OF URANIUM(VI) TO URANIUM(IV) IN CARBONATE SOLUTIONS AND SUBSEQUENT PRECIPITATION. 1. THE ELECTROLYSIS OF URANIUM(VI) IN SODIUM CARBONATE SOLUTIONS. V. Pravdic, M. Branica, and Z. Pucar (Institut "Rudjer Boskovic," Zagreb). Electrochem. Technol., 1: 312-15 (Sept.-Oct. 1963).

Conditions were investigated for the electrochemical reduction of uranium(VI) to uranium(IV) in sodium carbonate-bicarbonate solutions at mercury and platinum cathodes in a cell with cation exchange membranes separating cathode and anode compartments. A current density plateau was found only for the mercury cathode, in the potential range between −1.20 and −1.85 v vs SCE, which permits specific reduction of uranium(VI) with current efficiencies of over 80%. The reduction was performed so that no precipitation occurred in the electrolysis cell itself, the precipitation of uranium dioxide being carried out in a separate vessel. The possibilities of a large-scale process used based on the experimental work are discussed. (Uran. Abstr., 3: No. 2, Jan. 1964)

10061 ELECTRIC CONDUCTIVITY OF HIGH URANIUM OXIDES AS A FUNCTION OF TEMPERATURE. E. V. Tkachenko, A. D. Neuimin, V. G. Vlasov, and V. N. Strekalovskii. Fiz. Metal. i Metalloved., 16: 193-7(Aug. 1963). (In Russian)

Electric conductivity of uranium oxide at 80 to 800°C in a vacuum was determined, and additional data on the kinetics of oxide dissociation were obtained by x-ray analysis of the intermediate and finite UO_3 dissociations. It was found that at 250 to 300°C UO_3 dissociation does not change the structure, at 450°C UO_3 loses oxygen, and at higher temperatures it forms U_3O_8. (R.V.J.)

10062 OPTICAL PROPERTIES OF NIOBIUM INFRARED SPECTRA. M. M. Kirillova and B. A. Charikov (Inst. of Metal Physics, Academy of Sciences, USSR). Fiz. Metal. i Metalloved., 16: 205-8(Aug. 1963). (In Russian)

Dispersion of real and virtual parts in polycrystalline niobium dielectric penetrability was measured at 1 to 15 μ. Conducting electron and relaxation frequencies were determined, and contributions to the conductivity by electrons in partially filled d-bands were isolated. (tr-auth)

10063 RARE EARTH COMPOUNDS. I. RARE EARTH POLYSULFIDES. S. A. Ring and Melvin Tecotzky (Lockheed Missiles and Space Co., Palo Alto, Calif.). Inorg. Chem., 3: 182-5(Feb. 1964).

The polysulfides of Tb, Ho, and Er were prepared for the first time. New information was obtained for a number of rare earth polysulfides. A larger phase region with a more complex crystal structure was found to exist. Sulfur to metal atom ratios of 1.7 to 2.0 were found for the lightest rare earths and 1.7 to 1.8 for the heavier rare earths. As the atomic number of the metal component is increased, higher sulfur pressures at lower allowed temperatures are required to create the polysulfide phase. (auth)

10064 CRYSTAL STRUCTURE OF TERBIUM TRICHLORIDE. J. D. Forrester, Allan Zalkin, David H. Templeton, and J. C. Wallmann (Univ. of California, Berkeley). Inorg. Chem., 3: 185-8(Feb. 1964). (UCRL-10910)

X-ray diffraction data from poor single crystals of $TbCl_3$ show that the crystals are orthorhombic, space group Cmcm, with a = 3.86 ± 0.02, b = 11.71 ± 0.03, c = 8.48 ± 0.03 Å. The structure is the same as that of $PuBr_3$. Each Tb has Cl neighbors at the corners of a trigonal prism (two at 2.70 Å, four at 2.79 Å). Two more Cl neighbors (at 2.95 Å) are adjacent to two of the three lateral faces of the prism. (auth)

10065 HYDROLYSIS OF URANIUM CARBIDES BETWEEN 25 AND 100°. II. URANIUM DICARBIDE, URANIUM METAL–MONOCARBIDE MIXTURES, AND URANIUM MONOCARBIDE–DICARBIDE MIXTURES. Mildred J. Bradley and Leslie M. Ferris (Oak Ridge National Lab., Tenn.). Inorg. Chem., 3: 189-95(Feb. 1964). (ORNL-TM-462(Rev.1))

Reactions with water of as-cast uranium carbides with total-C : U atom ratios varying from 0.4 to 2.2 were investigated using gas chromatography for analysis of the gaseous products. Uranium metal–uranium monocarbide mixtures yielded 2 moles of free hydrogen per mole of free metal, methane, small quantities of higher molecular weight gaseous hydrocarbons, and a hydrous uranium(IV) oxide. The gaseous products contained all the carbon originally present in the mixtures. Uranium dicarbide ($UC_{1.85\pm0.03}$) yielded a mixture of 36 hydrocarbons (average composition (vol %): methane, 15%; ethane, 28%; C_3 to C_8 alkanes, 7%; alkenes, 8%; alkynes, 0.6%; and unidentified unsaturates, 1%), free hydrogen (40 vol %), a water-insoluble wax, and a hydrous, uranium(IV) oxide. Forty per cent of the combined carbon was found in the gas and 25% in the wax. Varying the reaction temperature between 25 and 99° caused no change in the hydrolysis products from either uranium mono- or dicarbide. Hydrolysis of uranium monocarbide–dicarbide mixtures resulted in a linear decrease in the volume % of methane and linear increases in the percentages of hydrogen and C_2 to C_8 hydrocarbons in the gas as the combined-C : U atom ratio increased from 1.0 to 1.85. Less methane was evolved from monocarbide–dicarbide mixtures than expected from the monocarbide concentrations, indicating that some polymerization of C units had occurred. (auth)

10066 HYDROGEN BONDING TO CHLORO AND BROMO COMPLEXES OF URANIUM(IV). J. L. Ryan (General Electric Co., Richland, Wash.). Inorg. Chem., 3: 211-14(Feb. 1964). (HW-SA-3123)

Spectrophotometric studies of nonaqueous solutions of U(IV) in the presence and absence of hydrogen bond donors were used to demonstrate the ability of the UCl_6^{2-} and UBr_6^{2-} complexes to form hydrogen bonds with primary, secondary, and tertiary alkylammonium ions and with hydronium ion. The hydrogen bonding partially distorts the octahedral field around the U^{4+} ion in the UCl_6^{2-} and UBr_6^{2-} complexes and thereby allows the normally forbidden electric dipole induced internal 5f electronic transitions to occur. The occurrence of such transitions in the hexachlorouranate(IV) complex in anion-exchange resins indicates distortion of the complex, most probably due to hydrogen bonding. (auth)

10067 ANHYDROUS LITHIUM THIOCYANATE. D. A. Lee (Oak Ridge National Lab., Tenn.). Inorg. Chem., 3: 289-90(Feb. 1964).

A method for the preparation of anhydrous lithium thiocyanate, LiSCN, and its physical properties are described. The heat of fusion and entropy of fusion were determined to be 5.0 ± 1.0 kcal/mole and 9 ± 2 eu/mole, respectively. The density is 1.43 g/ml at 26°C. The solubility of LiSCN in organic solvents is also discussed. (P.C.H.)

10068 DISSOCIATION KINETICS OF α-UO_3. V. G. Vlasov and A. R. Beketov. Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Met. i Gorn. Delo, No. 6, 110-15(Nov.-Dec. 1963). (In Russian)

Dissociation kinetics for hexagonal α-UO_3 were studied at 525 to 600°C. X-ray analysis showed that α-UO_3 and U_3O_8 form solid solutions with continuously varying composition. The activation energy in the initial stages (5% dissociation) is 40.2 kcal/mole, which coincides with the thermal reaction energy of 36.0 kcal/mole. (R.V.J.)

10069 ON THE β AND δ-OXYCARBIDES OF NIOBIUM. S. I. Alyamovskii, P. V. Gel'd, and G. P. Shveikin. Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Met. i Gorn. Delo, No. 6, 139-45(Nov.-Dec. 1963). (In Russian)

The composition of intermediate products produced in niobium oxide reactions with niobium carbides at 1300, 1500, 1700, and 1900°C was investigated. Hexagonal $Nb_2(C,O)$ and cubic Nb(C,O) were observed. An analysis was made of oxycarbide decomposition in vacuum at 1650 to 1700°C. It was found that hexagonal oxycarbide is more stable than cubic oxycarbide. (R.V.J.)

10070 ON THE VALENCE OF CERIUM IN SYNTHETIC AND NATURAL ALUMINATES AND SILICATES. II. CERIUM SILICATES. A. I. Leonov (Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 12, 2084-9(Dec. 1963). (In Russian)

The synthesis and properties of solid solutions of $Ce_2O_3 \cdot 2SiO_2$–$Nd_2O_3 \cdot 2SiO_2$ and $Ce_2O_3 \cdot 2SiO_2$–$La_2O_3 \cdot 2SiO_2$ were studied, and the effects of temperature and gas media on stability were analyzed. Temperature maximums in limited solutions ($xCe_2O_3 \cdot 2SiO_2$ and $yLa_2O_3 \cdot 2SiO_2$) in oxidizing atmospheres were found. Oxyorthosilicates of $Ce_2O_3 \cdot SiO_2$ and solid solutions with lanthanum subgroup elements and calcium, [(0.5 Ce, 0.2 La, 0.2 Nd, 0.1 Pr)$_2O_3 \cdot SiO_2$, (3CaO · SiO_2)], were synthesized in reducing atmospheres. (R.V.J.)

10071 PREPARATION OF URANIUM PEROXIDE HYDRATES. Taichi Sato (Government Chemical Industrial Research Inst., Tokyo). J. Appl. Chem. (London), 13: 361-5(Aug. 1963).

Uranium peroxide hydrates were prepared from uranyl nitrate solution and hydrogen peroxide under various con-

ditions. The materials were examined by thermogravimetry, x-ray diffraction, and infrared spectroscopy. The results showed that uranium peroxide hydrate exists in two different crystalline forms depending on the temperature of precipitation: UO_4, $4H_2O$ below 50°, UO_4, $2H_2O$ above 70°. The former is converted into the latter by drying in air at 100° or in vacuo for 24 hr at room temperature. (auth)

10072 THE PURIFICATION OF LITHIUM BY VACUUM DISTILLATION. A. G. Ward and G. H. Broomfield (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Appl. Chem. (London), 13: 329-34(Aug. 1963).

A vacuum still for lithium was constructed and operated. Analysis of lithium before and after distillation shows a reduction of concentration of most elements except oxygen; however, the available methods of analysis for oxygen are not considered reliable. Precise details of operations and difficulties with the design are included. It was concluded that purification of lithium to nuclear reactor standards is feasible. (auth)

10073 THE ELECTROCHEMISTRY OF THE DISSOLUTION OF ZIRCONIUM IN AQUEOUS SOLUTIONS OF HYDROFLUORIC ACID. Robert E. Meyer (Oak Ridge National Lab., Tenn.). J. Electrochem. Soc., 111: 147-55(Feb. 1964).

The dissolution of crystal-bar zirconium in aqueous solutions containing HF and H_2SO_4 was investigated by means of electrochemical techniques. Capacities were determined by measuring the initial slope of the voltage-time curve resulting from the application of galvanostatic pulses. Steady-state polarization curves were obtained potentiostatically whenever possible, and galvanostatic polarization curves were determined by a pulse technique. The data are explained by assuming that the dissolution reaction involves the continuous formation and dissolution of a film on the surface of the metal. The conventional anodizing equation describes the formation of the film and the dissolution reaction is controlled by the rate of mass transfer of undissociated HF to the surface of the film. (auth)

10074 ON THE OXYCARBONATE OF THORIUM. Smt. E. B. Mirza and M. D. Karkhanavala (Atomic Energy Establishment, Trombay, India). J. Indian Chem. Soc., 40: 903-4(Oct. 1963).

A thermogravimetric study was made on thorium oxycarbonate, $ThOCO_3 \cdot 2H_2O$. Thermogravimetric curves showed a continuous decomposition with no definitely marked step as is obtained for normal carbonates. Decomposition was somewhat rapid at the start and then attained a constant rate to about 350°C when the loss was 18% and corresponded to 1 molecule each of H_2O and CO_2. The substance on further heating lost only H_2O to 500°C when a residue of ThO_2 was obtained. From the results it was concluded that the CO_2 is not attached as the CO_3^{2-} ion to thorium, but is present only as molecular CO_2 weakly attached to the thorium hydroxide or the hydrated oxide, thus $Th(OH)_4CO_2$ or $ThO_2 \cdot 2H_2O \cdot CO_2$. However, the latter is not considered likely. It is considered that the formula of the precipitates could be best represented as either $Th(OH)_4 \cdot CO_2$ or $Th(OH)_3 \cdot HCO_3$. (P.C.H.)

10075 THE INFRA-RED SPECTRA OF METAL NITRATES IN ORGANIC SOLVENTS. J. M. P. J. Verstegen (Institutt for Atomenergi, Kjeller, Norway). J. Inorg. Nucl. Chem., 26: 25-35(Jan. 1964).

The infrared spectra of metal nitrates in tri-n-octyl phosphine oxide solution in carbon tetrachloride and in tri-n-octyl amine nitrate solution in benzene are reported. The splitting of the ν_3 band of the nitrate ion was followed and frequency shifts in the solvent molecule are discussed. A comparison was made with previous measurements in 100% tri-n-butyl phosphate. From the results conclusions are drawn concerning species present in the amine nitrate phase. It is shown that the location of the NO asymmetric and symmetric stretch of the metal nitrate is independent of the solvent, but strongly dependent on the metal ion. (auth)

10076 SOLID COMPLEXES WITH TETRAVALENT METAL IONS AND ETHYLENEDIAMIME TETRA-ACETIC ACID (EDTA). H. G. Langer (Dow Chemical Co., Framingham, Mass.). J. Inorg. Nucl. Chem., 26: 59-72(Jan. 1964).

Stable, crystalline acidic 1:1 EDTA chelates could be obtained with tetravalent germanium, tin, titanium, zirconium, hafnium, and thorium. In acidic solution, the preparation of these slightly soluble compounds is straightforward—in contrast to other, previously reported methods—and yields very pure materials. All chelates are hydrated. In the case of octa-co-ordinated metals, the water is loosely bound, for hexa-co-ordinated metals, it is part of the molecule and has a strong influence on the infra-red spectra. This difference in water co-ordination has been shown by analytical data, infra-red spectra, and heat treatments. Addition of base leads to hydrolysis which is complicated for all Group IVB metal chelates, but which results in characteristic salt formation for both germanium and tin EDTA. Changes in the infrared absorptions after hydrolysis and after heat treatment were helpful for the interpretation of bonding in the original chelates. (auth)

10077 THE PREPARATION OF CRYSTALLINE ZIRCONIUM PHOSPHATE AND SOME OBSERVATIONS ON ITS ION EXCHANGE BEHAVIOUR. A. Clearfield and J. A. Stynes (National Lead Co. and Niagara Univ., New York). J. Inorg. Nucl. Chem., 26: 117-29(Jan. 1964).

The stoichiometry and dehydration behavior of gelatinous zirconium phosphate preparations were determined. Refluxing the gelatinous products in phosphoric acid resulted in the formation of a truly crystalline product. The crystals have approximately the same composition as the gels but exhibit somewhat different dehydration behavior. Both forms of zirconium phosphate are represented by the formula $Zr(HPO_4)_2 \cdot H_2O$. Sodium ion exchange capacity measurements show that the crystalline zirconium phosphate contains two replaceable hydrogen ions per zirconium phosphate molecule. The exchange capacity of the gels approach but never equal this value. The crystals do not exchange with cesium ion whereas the gels have a high cesium exchange capacity. A tentative explanation for this behavior is presented based on structural considerations. (auth)

10078 THE THERMAL DECOMPOSITION OF HYDRATED PLUTONIUM(IV) OXALATES. I. L. Jenkins and M. J. Waterman (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. Nucl. Chem., 26: 131-7 (Jan. 1964).

The thermal decomposition of the hydrated plutonium(IV) oxalates was studied in air and in nitrogen over the temperature range 20 to 830°C. In air the oxalates begin to lose water of hydration at 45 to 60°C, and in the temperature range 200 to 290°C a mixture of PuO_2 and $Pu(CO_3)_2$ is formed. No evidence for the formation of any stable intermediate hydrate, of anhydrous plutonium(IV) oxalate or of plutonium(III) oxalate was found. In the decomposition of nitrogen, an intermediate corresponding to $Pu(CO_3)_2$ was found, but there was no indication of plutonium(III) oxalate. (auth)

10079 THE PREPARATION, X-RAY AND INFRA-RED DATA OF PRASEODYMIUM AND NEODYMIUM PERCHLORATES. M. Steinberg, I. Mayer, and I. Shidlovsky (Hebrew

Univ., Jerusalem). J. Inorg. Nucl. Chem., 26: 204-6(Jan. 1964).

Praseodymium and neodymium perchlorates were prepared and found to have the formula $Pr(ClO_4)_3 \cdot 3H_2O$ and $Nd(ClO_4)_3 \cdot 4.5H_2O$, respectively. The powder patterns of Pr and Nd perchlorates may be indexed on the basis of a cubic cell, the lattice constants being 12.12 and 12.09 Å for Pr and Nd, respectively. The cubic patterns of the hydrated perchlorates contain only lines with odd or even indices indicating a fcc lattice. The infrared spectra of the Pr and Nd perchlorates were nearly identical. Absorbances at 9μ region (1000–1020 cm^{-1}), 10.6μ (940 cm^{-1}), and 16μ (630–650 cm^{-1}) are characteristic for the perchlorate ion absorbance. (P.C.H.)

10080 EFFECTS OF ADDITIVES AND PREPARATION CONDITIONS ON ISOTOPIC EXCHANGE OF ZINC OXIDE OXYGEN. V. I. Gorgoraki, L. A. Kasatkina, and V. Yu. Levin (Moscow Inst. of Chemistry and Tech.). Kinetika i Kataliz, 4: 863-6(Nov.-Dec. 1963). (In Russian)

The influence of Li, Ga, and In admixtures and preparation conditions on the isotopic exchange of oxygen in ZnO were analyzed. It was found that an increased ZnO aging temperature, from 850 to 1200°C, increased the rate of isotopic exchange. Additions of Li (0.5 and 0.7 at.%), introduced at 850°C, accelerated the rate of exchange. Additions of Ga and In, introduced at 850°, slowed the exchange. (R.V.J.)

10081 KINETICS OF TRITIUM EXCHANGE BETWEEN STEAM AND HYDROGEN ON NICKEL CATALYSTS. A. M. Taikhert, N. M. Morozov, and M. I. Temkin (Karpov Inst. of Physics and Chemistry, Academy of Sciences, USSR). Kinetika i Kataliz, 4: 904-9(Nov.-Dec. 1963). (In Russian)

Investigations were made of the kinetics of the isotopic exchange $HTO_{gas} + H_2 = H_2O_{gas} + HT$ on nickel catalysts. The kinetic equation $HDO_{gas} + H_2 = H_2O_{gas} + HD$ was also verified. (R.V.J.)

10082 PREPARATION OF A COLLOIDAL SUSPENSION OF P^{32} CHROMIUM PHOSPHATE. M. Mortreuil (Commissariat a l'Energie Atomique, Saclay, France). Minerva Nucl., 7: 446-7(Nov. 1963). (In French)

A method for the preparation of colloidal suspension of P^{32} chromium phosphate and subsequent controls performed both to assess its dimensions and to control its radiochemical purity is described. (auth)

10083 PREPARATION OF COLLOIDAL GOLD-198. M. Douis (CEN, Saclay, France). Minerva Nucl., 7: 448-50(Nov. 1963). (In French)

Reference is made to the principle on which the method of preparing radioactive colloidal gold is based and the technical details of this method, as well as the characteristics of the gold obtained, are illustrated schematically. Mention is made of the tests carried out on all radioactive colloid preparations destined for medical use. (auth)

10084 ANOMALOUS AND NON-EQUILIBRIUM BREAKS IN FUSED SALT THERMAL ANALYSIS CURVES. C. E. Johnson, C. E. Crouthamel, and S. E. Wood (Argonne National Lab., Ill.). Nature, 201: 293-4(Jan. 18, 1964).

An anomalous break in the cooling curves for the LiCl–LiH system is explained. Solid LiCl separates and collects on the walls of the sample cup. When the first LiCl appears, the centrally located thermocouple was recording a temperature somewhat above the true solid-liquid equilibrium temperature. The unexpected and sharp break appeared when the liquid salts trapped in the center of a shell of solid LiCl lost wet contact with the sample cup. The loss in contact caused an abrupt change in the rate of flow of heat from the liquid sample surrounding the thermocouple. Since no problems were encountered in studies of the LiH rich portion of the system, it was postulated that the thermal conduction characteristics of the two salts differ considerably. A new thermowell containing circular heat conducting fins 0.010 in. thick that extend to the wall of the sample cup was designed to correct the problem. This way accurate liquid-solid breaks were obtained both on heating and cooling. (P.C.H.)

10085 DIFFUSION IN SILICA GLASS FOLLOWING REACTION WITH TRITIATED WATER VAPOUR. T. Drury and J. P. Roberts (Univ. of Leeds, Eng.). Phys. Chem. Glasses, 4: 79-90(June 1963).

Tritiated water was found to be suitable for tracer work on the diffusion of water in glass. Diffusion profiles in silica glass were determined accurately, and showed that the diffusion coefficient varies with concentration and that the form of the concentration-dependence varies markedly with temperature, especially in the transformation range. The temperature-dependence of the solubility differs above and below the transformation range. Distinct differences in diffusion behavior and in solubility were observed among different batches of the glass. (auth)

10086 AN EXPERIMENTAL EQUATION OF STATE FOR SOLID XENON. J. R. Packard and C. A. Swenson (Ames Lab., Ames, Iowa). Phys. Chem. Solids, 24: 1405-18(Dec. 1963). (IS-663)

The pressure-volume-temperature relation for solid xenon was determined to 20 kbars pressure from 20 to 160°K. Approximate values for the zero pressure thermal expansion and bulk modulus are given, along with their pressure dependence. The extrapolated absolute zero P–V isotherm cannot be fitted by a theoretical curve based on a Lennard-Jones 6-12 potential, and the solid appears to be more compressible at high pressures than the theory would predict. The temperature-dependent contributions to the equation of state are small and cannot be determined with precision. The thermal pressure P^* is approximately independent of volume at constant temperature, although it appears to decrease slightly with decreasing volume. This implies that the bulk modulus tends to decrease with increasing temperature at constant volume. Various inconsistencies in the thermodynamic data and definitions of the Grueneisen constant are discussed. The only general conclusion that can be drawn is that for temperatures greater than θ_D the Grueneisen constant is apparently a linear function of the molar volume at constant temperature. (auth)

10087 OVERLAP FUNCTIONS IN PLANAR CRYSTALS. V. Halpern (Mathematical Inst., Oxford). Phys. Chem. Solids, 24: 1495-1502(Dec. 1963).

The overlap function $F^2 = |\int u_k^*(r) u_{k'}(r) dr|^2$ is evaluated for several values of k and a wide mesh of points k′, where u_k is the modulating part of the Bloch wave function for a π-electron in the valence or conduction band, in planar boron nitride and graphite. It was found that for boron nitride, if u_k and $u_{k'}$ are in the same band and $|k - k'|$ is less than a quarter of the radius of the Brillouin zone, then F^2 usually lies between 0.9 and 1. In graphite, however, F^2 behaves more erratically because the top of the valence band is degenerate with the bottom of the conduction band; a theoretical analysis of this behavior is also presented. (auth)

10088 CALCIUM TUNGSTATE. III. TRIVALENT RARE EARTH SUBSTITUTION. K. Nassau and G. M. Loiacono (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Chem. Solids, 24: 1503-10(Dec. 1963).

The charge compensation of trivalent rare earths in the divalent Ca site of calcium tungstate was studied by the

determination of distribution coefficients. The behavior of neodymium was investigated in the presence of all the alkali metal ions and niobium, and all the other rare earths in the presence of sodium. The distribution coefficient of Nd was found to vary with the concentration of Nd itself, as well as with the concentration of charge compensating ions present. Several separate mechanisms including vacancy formation are inferred, and were confirmed by paramagnetic resonance results. Columnar growth was observed and can be caused by either CaO or WO_3 excess in the melt. (auth)

10089 CALCIUM TUNGSTATE. IV. THE THEORY OF COUPLED SUBSTITUTION. K. Nassau (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Chem. Solids, 24: 1511-17(Dec. 1963).

A theory is developed for the coupled substitution of Nd^{3+} and Na^+ in Ca^{2+} sites in the scheelite ($CaWO_4$) lattice. Allowance is made for Schottky defect formation. The results fit the $CaWO_4$: Nd system up to 2% Nd, the $CaWO_4$: Nd: Na system up to 15% Na and 5% Nd, and the $CaWO_4$: Nd: K system up to 8% K and 2% Nd. Equilibrium constants resulting from the theory give the vacancy concentrations in O and Ca sites as 0.054% each and the free energy of formation of a pair of vacancies as 55 kcal or 2.4 ev, all in pure $CaWO_4$ in air at the melting point. Energies are also obtained for the various other substitution arrangements. For exactly balanced substitution of one Na^+ for each Nd^{3+} in the crystal, it is necessary to use 4.05 Na for each Nd in the melt. This also results in the minimum number of vacancies in the crystal. (auth)

10090 PRESSURE EFFECT ON COLOR CENTERS IN RbF, RbCl, RbBr AND CsI. Hans Knof and William G. Maisch (Univ. of Maryland, College Park). Phys. Chem. Solids, 24: 1625-31(Dec. 1963).

The absorption spectra of the F and M centers in RbF, RbCl, RbBr, and CsI were investigated as a function of pressure. In addition to the F and M bands, the No. 3 band and some other unidentified bands were also observed. The experiments were conducted at room temperature with both electrolytically and additively colored crystals. Frequency shifts were observed under pressures up to 10000 atm for the absorption spectra of RbCl and RbBr and up to 50000 atm for the absorption spectra of RbF and CsI. In RbF a phase transition appears at 33000 atm. The pressure dependence of the frequency shift in the rubidium halides is similar to that in the potassium halides. (auth)

10091 NEUTRON INELASTIC SCATTERING MEASUREMENTS OF ANTIFERROMAGNETIC EXCITATIONS IN MnF_2 AT 4.2°K AND AT TEMPERATURES UP TO THE NEEL POINT. A. Okazaki (Atomic Energy Research Establishment, Harwell, Berks, Eng.), K. C. Turberfield, and R. W. H. Stevenson. Phys. Letters, 8: 9-11(Jan. 1, 1964).

The antiferromagnetic properties of MnF_2 were studied using a twin-rotor neutron time-of-flight spectrometer. Spin wave dispersion relations were obtained for propagation in the (100) and (001) directions at 4.2°K. Decreasing spin wave energies and increasing line widths were observed as the crystal temperature increased from 4.2 to 62.0°K. Spin-wave-like fluctuations were observed at 66.3°K and just above the Neel point (67.0°K) at 68.5 and 70.7°K. Spin wave interaction theory described the dispersion fairly well. (auth)

10092 OPTICAL PROPERTIES OF LANTHANUM COBALTITE EXPLAINED BY SMALL POLARON THEORY. H. G. Reik (Technische Hochschule, Braunschweig, Ger.), E. Kauer, and P. Gerthsen. Phys. Letters, 8: 29-30(Jan. 1, 1964).

Some properties of $LaCoO_3$ were calculated for the range of wavelengths between the reststrahl region and the fundamental absorption. The theoretical results agree quite well with experimental results. (D.C.W.)

10093 NUCLEAR QUADRUPOLE INTERACTIONS IN BERYLLIUM OXIDE. T. T. Taylor and T. P. Das (Univ. of California, Riverside). Phys. Rev., 133: A1327-33 (Mar. 2, 1964).

The importance of the contribution from higher multipole moments of oxygen ions to the electric field gradient at nuclei in a wurtzite-type ionic oxide, namely, beryllium oxide, is considered and, in particular, oxygen dipole moments are found to contribute significantly to the field gradient at beryllium ion sites. The dipolar polarizability of an oxygen ion bound in a beryllium oxide lattice is analyzed and a value of 2.19 $Å^3$ is obtained. Using 7.0 $Å^5$ for the quadrupolar polarizability of the same ion and considering the slight uncertainty associated with the sublattice displacement parameter u, the experimental quadrupole coupling constant for the Be^9 nuclei, $\pm 41 \pm 4$ kc, can be explained. The quadrupole coupling constant for O^{17} nuclei is also investigated and presented as a function of u. In this case, oxygen dipole moments do not contribute because of lattice symmetry; oxygen quadrupole moments do contribute, however. (auth)

10094 VIBRONIC SPECTRA OF SrF_2: Sm^{+2} AND BaF_2: Sm^{+2}. Isaac Richman (Aerospace Corp., El Segundo, Calif.). Phys. Rev., 133: A1364-6(Mar. 2, 1964).

Recent work of Wood and Kaiser yielded vibronic data on Sm^{2+} doped in two isomorphic crystals, SrF_2 and BaF_2. A model using Born-von Karmann boundary conditions, which predicts the number of vibronic satellites and the k = 0 selection rules, is proposed. It is shown, however, that the k = 0 selection rules are too restrictive to explain the vibronic spectrum and that to obtain a satisfactory explanation one must consider transitions involving vibrations away from k = 0. The model, when such transitions are taken into account, is shown to be consistent with the observed data. It is proposed that one of the modes observed in the vibronic spectrum corresponds to vibrations of the transverse optical branch, a second to the longitudinal optical branch, and a third to transitions away from k = 0 involving the Raman active branch. This model is able to qualitatively explain the differences observed in the two host lattices. It is contrasted with an XY_8 complex model, proposed by Axe and Sorokin to explain the same data. Raman scattering data were obtained placing the F_{2g} mode (at k = 0) at 280 cm^{-1} in SrF_2 and at 243 cm^{-1} in BaF_2. (auth)

10095 THEORY OF THE ELECTRONIC SUSCEPTIBILITIES OF STOICHIOMETRIC RUTILE (TiO_2). A. R. Ruffa (National Bureau of Standards, Washington, D. C.). Phys. Rev., 133: A1418-26(Mar. 2, 1964).

A theoretical analysis of the symmetry properties of crystalline rutile is made, leading to the conclusion that the isotropic solution of the local field equations for this material is correct. It is shown that this conclusion is supported by the experimentally determined isotropic nature of the magnetic susceptibility of rutile. The isotropic solution of the local field equations yields a value for the electronic polarizability of the titanium ion in rutile of $\alpha_T = 2.2$ $Å^3$, an order of magnitude greater than the free ion values usually assigned to the Ti^{4+} ion. This result is supported by a correlation of the ionic sizes as obtained from an electron-density map of rutile determined by x-ray analysis with the polarizabilities in a manner described previously. In addition, this conclusion is in reasonably

good quantitative agreement with a theoretical prediction made previously of the effect of the crystalline potential on the cation polarizability. The results of this study give a specific example of a conclusion arrived at in an earlier work to the effect that a cation polarizability in a crystal may be many times its free-ion value. Moreover, it demonstrates the unreliability of the usually accepted additivity rule for the ionic radii. (auth)

10096 EVIDENCE FOR AN ISOTOPIC SHIFT IN THE ELECTRON-SPIN-RESONANCE ABSORPTION-SPECTRUM OF Fe^{3+} IN CALCITE. S. A. Marshall, J. A. Hodges, and R. A. Serway (Illinois Inst. of Tech., Chicago). Phys. Rev., 133: A1427-31(Mar. 2, 1964).

The hyperfine structure spectrum of trivalent iron located substitutionally for calcium in calcite was studied at a wavelength of 3 cm. At 77°K, the hyperfine splitting tensor of Fe^{57} was found to be isotropic with a value A = (–11.23 ± 0.04) Oe. This result was obtained from data taken on seven separate fine structure transitions, five at $\theta = 0$ and two at $\theta = \frac{1}{2}\pi$. An analysis of the hyperfine structure components taken at $\theta = 0$ showed that aside from the fact that Fe^{57} has a nuclear spin of $\frac{1}{2}$, its fine structure spectrum is measurably different from that of Fe^{56} whose nucleus has zero spin. The difference in the two fine structure spectra can be explained by a shift in the crystal-field constants of Fe^{57} with respect to Fe^{56} with no measurable shift in the spectroscopic splitting factor. The shifts in B_2^0 and B_4^0 for Fe^{57} using the values for Fe^{56} as references are given by $\delta B_2^0 = (2.0 \pm 0.2) \times 10^{-2}$ Oe and $\delta B_4^0 = (-1.3 \pm 0.7) \times 10^{-4}$ Oe. Spectral shifts due to Fe^{54} relative to Fe^{56} were also detected and found to be opposite in sign and approximately twice the magnitude of the shifts due to Fe^{57}. These measurements were repeated at 4.2, 50, and 112°K and to within experimental errors, the results exhibited no temperature dependence. (auth)

10097 OXYGEN VACANCIES AND ELECTRICAL CONDUCTION IN METAL OXIDES. C. J. Kevane (Arizona State Univ., Tempe). Phys. Rev., 133: A1431-6(Mar. 2, 1964).

Oxygen vacancies and their effects on electrical conduction in some metal oxides were considered through an exact solution of the equilibrium relations between oxygen partial pressure in the ambient gas and concentrations of oxygen vacancies and conduction electrons in the oxide. The mass-action law was assumed but no state of ionization of oxygen vacancies was neglected. Concentrations of electrons in conduction states and total oxygen vacancies were considered. The results, which possess considerable complexity not contained in the usual limiting-case solutions, were compared with pertinent experiments. (auth)

10098 ELECTRONIC STRUCTURE OF THE M CENTER IN LiCl AND LiF. Axel Meyer and R. F. Wood (Oak Ridge National Lab., Tenn.). Phys. Rev., 133: A1436-42 (Mar. 2, 1964).

Experimental work of the past few years has fairly conclusively established that the M center in alkali halides consists of two F centers bound together at neighboring halide sites. Using this model, the wave functions and energy levels of the M center in LiCl and LiF are calculated in the Heitler-London approximation. The F-electron wave functions used in the calculations are of the vacancy-centered type. The finite extension of the neighboring alkali ions is treated but all other ions are considered to be point charges. The results of the calculations show that there is a transition energy that corresponds closely to the observed M_1 band. In addition, there are numerous possibilities for other transitions, all giving energies that cluster in the vicinity of the main F-band energy. The results for the M_1 band follow the empirical Ivey relation quite well. (auth)

10099 RADIOTRACER TECHNIQUES IN THE STUDY OF ELECTRODEPOSITION PHENOMENA. Seward E. Beacom and Bernard J. Riley (General Motors Corp., Detroit). Record Chem. Progr. (Kresge-Hooker Sci. Lib.), 24: 75-91(Mar. 1963).

The way in which radiotracer techniques were used to study problems in electrodeposition is discussed. The mechanisms by which organic addition agents preferentially adsorb onto cathodes, interact synergistically, and are included in deposits to so modify the deposition process in nickel plating baths as to produce leveling deposits were studied. Radioactive sodium allyl sulfonate (SAS) was used as the addition agent in a Watts-type nickel bath. Preparation of the addition agent and grooved cathodes, plating procedures, counting techniques, autoradiography, inclusion as a function of current density, the breakdown and inclusion of addition agents, interactions of addition agents, contributions to leveling theory, and synergism in the leveling process are discussed. (M.C.G.)

10100 APPLICATION OF RADIOISOTOPES IN POLAROGRAPHY. NOTE III. DETERMINATION OF THE VALENCY OF ELECTRODICAL PROCESSES BY MEANS OF A RADIOACTIVE SILVER MICROCOULOMETER. Loris Busulini and Enrico Naldi (Università, Padua; CNR, Padua; CNEN, Padua; and CNR, Bologna). Ric. Sci., Rend., Ser. A, 3: 813-18(Sept. 1963). (In Italian)

A method for the determination, in polarographic conditions, of electrodic processes valence, using a radioactive-silver microcoulometer was developed. A description is given of the electrolytic cell, and of the operations required. The results are in good agreement with those known in literature. The reproducibility and the precision of the measurements are good. (auth)

10101 ACID OF KRYPTON AND ITS BARIUM SALT. A. G. Streng and A. V. Grosse (Research Inst. of Temple Univ., Philadelphia). Science, 143: 242-3(Jan. 17, 1963).

An acid of krypton is formed when krypton tetrafluoride is slowly hydrolyzed by ice at –30 to –60°C. The yield is 2 to 3 percent (mole). A barium salt of this acid, thermally stable at room temperature, is formed by the hydrolysis of krypton tetrafluoride with a 0.35N solution of barium hydroxide at 0 to 5°C in a yield of approximately 7 percent by weight. (auth)

10102 SORPTION OF RARE EARTH CATIONS ON CATIONITE. I. NEODYMUM–HYDROGEN EQUILIBRIUM IN THE SYSTEM SOLUTION–CATIONITE AT 25°. M. E. Cornelli and I. A. Legenchenko (Inst. of General and Inorganic Chemistry, Odessa). Ukr. Khim. Zh., 29: 359-63 (1963). (In Russian)

Ion exchange equilibrium of neodymium and hydrogen on cation resins was investigated, and an exchange isotherm was developed. Exchange coefficients and total exchange volume were calculated using equilibrium curves. The obtained magnitudes were in agreement with published data. (R.V.J.)

10103 SORPTION OF RARE-EARTH CATIONS ON CATIONITE. III. KINETICS OF THE SORPTION OF RARE-EARTH ELEMENTS ON KU-2 RESIN IN AMMONIAC AND SODIUM FORMS. M. E. Kornelli and I. A. Legenchenko (Inst. of General and Inorganic Chemistry, Odessa). Ukr. Khim. Zh., 29: 1147-50(1963). (In Russian)

Kinetics of La, Nd, and Gd sorption from dilute solutions on sodium and ammonium cation resins were studied. Calculated rates and activation values were identical; the val-

ues diminished in transition from one resin to another in the series HR → NaR → NH_4R. (R.V.J.)

10104 COMPLEX OF THORIUM(IV) WITH XYLENOL ORANGE. B. I. Nabivanets and L. N. Kudritskaya (Inst. of General and Inorganic Chemistry, Odessa). Ukr. Khim. Zh., 29: 1198-1205(1963). (In Russian)

Spectrophotometric, potentiometric, and electromigration methods were used in an investigation of Th(IV) reactions with Xylenol Orange (H_6KO) in weakly acid media. It was found that the cationic complex $Th(H_3KO)^+$ formed at pH 2 and $Th(H_3KO)_2^{3-}$ formed at pH 4 to 5. Instability constants for colored complexes were calculated considering the Xylenol Orange dissociation constant equal to μ 0.01 at 18°C: $K_1 = [(Th^{4+})(H_3KO^{3-})]/[Th(H_3KO)^+] = 1.0 \times 10^{-8}$; $K_2 = \{[Th(H_3KO)^+][H_3KO^{3-}]/[Th(H_3KO)_2^{3-}]\} = 1.1 \times 10^{-6}$; and $K_n = K_1 \times K_2 = [(Th^{4+})(H_3KO^{3-})^2]/[Th(H_3KO)_2^{3-}] = 1.1 \times 10^{-14}$. (R.V.J.)

10105 OBSERVATIONS OF CHEMICAL REACTIONS IN BORON-CONTAINING GRAPHITE PELLETS IN THE DIRECT-CURRENT ARC. H. Nickel (Kernforschungsanlage, Jülich, Ger.). Z. Anal. Chem. 198: 55-70(1963). (In German)

Graphite pellets containing 5 wt % boron in the form of B, B_2O_3, H_3BO_3, BN, $Na_2B_4O_7$, CaB_4O_7, B_2O_3 + NaCl, or B + NaF, respectively, are heated in argon–oxygen atmosphere in a d-c arc. The discharged pellets were sectioned and investigated by x-ray diffraction. The results were correlated with thermo-chemical calculations, kinetic considerations, and with the observed intensities of the boron lines. In all cases, B_4C was formed. The reaction rates were controlled by solid state diffusion. Most favorable for B_4C formation was elementary boron. The other compounds at reaction temperature formed volatile or gaseous products, which were lost through channels and cracks and by diffusion and fractionation through the electrode walls. The B_4C formation was favored by Na and Ca compounds. An increased material transport within the excitation zone caused by the carrier effect of the gaseous products was noted. (auth)

10106 VISCOSITY OF LIQUID HYDROGEN AND DEUTERIUM. N. S. Rudenko and V. G. Konareva (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Fiz. Khim., 37: 2761-2(Dec. 1963). (In Russian)

The viscosities of liquid hydrogen and deuterium were measured between 20.4°K and the hardening point. The results were in agreement with published data. (R.V.J.)

10107 SATURATED VAPOR PRESSURE IN METALLIC SAMARIUM. O. G. Polyachenok and G. I. Novikov. Zh. Obshch. Khim., 33: 2796-7(Aug. 1963). (In Russian)

The saturated vapor pressure of 99.5% pure metallic samarium at 1100 to 1350°C was described by $\lg P = 7.30 - 8300/T$, where the heat of evaporation was 38 ± 1 kcal/g-at. at an average temperature of 1220°C. An equation was developed that holds for a wide temperature range ($\lg P = 27.32 - 11910/T - 5.54 \lg T$). On the basis of this equation the samarium boiling point is 1624°C, the ΔH for evaporation is 33.6 kcal/g-at., and $\Delta S = 17.7$. (R.V.J.)

10108 INVESTIGATION OF RARE EARTH DICHLORIDES. O. G. Polyachenok and G. I. Novikov. Zh. Obshch. Khim., 33: 2797(Aug. 1963). (In Russian)

Melting diagrams of $SmCl_3$–Sm, $ScCl_3$–Sc, and YCl_3–Y were constructed. A stable dichloride, $SmCl_2$ (melting point 859°C), and an intermediate compound $SmCl_3 \cdot 4SmCl_2$ were observed in the SmCl–Sm system. Reactions of $SmCl_3$ with metallic Sm produced pure $SmCl_2$, and reduction of the tetrachlorides by metallic zinc produced $EuCl_2$ and YCl_2. Measurements of saturated vapor pressures of $LaCl_3$–La, $PrCl_3$–Pr, $NdCl_3$–Nd, YCl_3–Y, and $ScCl_3$–Sc indicated atomic solutions of La and Y and the formation of Pr^{2+}, Nd^{2+}, and Sc^{2+} ions. Standard enthalpies of formation for $NdCl_2$ and $NdCl_3$ were −163.2 and −246.5 kcal/mole, and for solid solutions of PrCl and $ScCl_2$, −163 and −145 kcal/mole. (R.V.J.)

10109 SINTERING AND PHYSICO-TECHNICAL PROPERTIES OF LANTHANUM SILICATES. A. B. Adreeva and E. A. Keler (Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Zh. Prikl. Khim., 36: 2605-10(Dec. 1963). (In Russian)

Studies showed that lanthanum silicates form at 1400°C; however, true sintering does not occur even at 1600 to 1700°C (porosity >20%). Preliminary sintering at 1500°C with admixtures of finely ground mineralizer (2 to 3% CeO_2), followed by heating under pressure at 1600 to 1650°C, produced stable silicates. Lanthanum pyrosilicates, $La_2O_3 \cdot 2SiO_2$, proved stable in air. (R.V.J.)

10110 TECHNIQUES FOR THE STUDY OF COMBUSTION OF BERYLLIUM PARTICLES. A. Macek, R. Friedman, and J. M. Semple (Atlantic Research Corp., Alexandria, Va.). New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-485, 6p, $1.00. (CONF-391-2)

From AIAA Heterogeneous Combustion Conference, Palm Beach, Fla., Dec. 1963.

Minimum ignition temperatures for single beryllium particles, under total pressures of up to 50 atmospheres, range from 2380 to 2650°K depending on the partial pressure of oxygen in the ambient gas. Atmospheric pressure photographic studies of fine details of aluminum combustion were also made and are discussed qualitatively. (auth)

10111 ENTHALPY DIFFERENCE OF HEXAGONAL AND RHOMBOHEDRAL GRAPHITE. H. P. Beohm and R. W. Coughlin (Universität, Heidelberg). 12p. (CONF-73-21)

From 6th Biennial Conference on Carbon, Pittsburgh, June 1963.

An isothermal calorimeter used for measuring the heat of formation of potassium graphite, C_8K, is described. The observed heat of reaction was −84.1 ± 0.3 Cal/gc using pure hexagonal graphite, but −88.1 ± 1.1 Cal/gc using graphite containing 33% rhombohedral modification. From the results, it was calculated that 0.14 ± 0.04 kcal/g-atom is liberated upon transition of rhombohedral into hexagonal graphite. Only by mechanical treatment, such as grinding, can the rhombohedral modification be obtained. Estimation of the energy stored in the lattice defects produced by grinding leads to values significantly lower than those measured. (auth)

10112 PROJECTED MOLECULAR BEAM RESEARCH AT THE APPLIED PHYSICS LABORATORY. R. M. Fristrom (Johns Hopkins Univ., Silver Spring, Md.). 3p. (CONF-290-2)

From Conference on Molecular and Atomic Gas Beams, Charlottesville, Va., May 1963.

An apparatus is described that is used in the study of elementary chemical reactions using the crossed molecular beam technique. A time-of-flight mass spectrometer is used as a detector and the velocity and angular distributions of the scattered species are measured directly. Schematic representation of the scope detector and the results of $H + O_2 \rightarrow OH + O$ are given. (R.E.U.)

10113 PHASE RELATIONS IN A PORTION OF THE SYSTEM Sc_2O_3–ZrO_2. D. W. Strickler and W. G. Carlson

(Westinghouse Research Labs., Pittsburgh). 21p. (CONF-45-2)

From American Ceramic Society Basic Science Division Meeting, Washington, D. C., Oct. 1963.

X-ray diffraction, differential thermal analysis, quench techniques, electrical conductivity measurements, and microscopic examination were used to determine the phase relations in the ZrO_2-rich portion of the $Sc_2O_3-ZrO_2$ system. Two birefringent compounds with the approximate formulae $Sc_2Zr_2O_7$ and $Sc_2Zr_7O_{17}$ were found to occur in the system. $Sc_2Zr_2O_7$ inverts to a cubic form at about 1250°C. The inversion temperature is depressed with the addition of ZrO_2 in solid solution and at the solid solution limit of 16 mole % Sc_2O_3, the inversion temperature is about 800°C. $Sc_2Zr_7O_{17}$ is rhombohedral at room temperature and inverts to cubic structure at 610°C. Up to two mole % Sc_2O_3 enters ZrO_2 in solid solution and depresses the monoclinic ZrO_2 inversion to about 750°C. The data presently available indicate little or no solid solution of Sc_2O_3 in the low temperature form of $Sc_2Zr_2O_7$. (auth)

10114 PROCESSES FOR THE PRODUCTION OF URANIUM OXIDE. Allan Robert Gibson, Ronald George Avery, and Leonard Lewis Wassell (to United Kingdom Atomic Energy Authority). U. S. Patent 3,117,836. Jan. 14, 1964. Priority date Sept. 25, 1959, Great Britain.

Pure uranium dioxide is produced from an impure uranium oxide ore concentrate by suspension in a fused melt having an alkali metal chloride or an alkaline earth metal chloride present. The melt containing the uranium oxide is contacted with chlorine in the presence of carbon for complete chlorination and formation of uranium tetrachloride. The melt is then contacted with oxygen to produce uranyl chloride, then with hydrogen to produce uranium dioxide, and then purification is effected by electrolysis of the melt. Further purification is again by electrolysis. (R.E.U.)

Organic Chemistry

10115 (EIR-58) I-131-LABELED POLYVINYLPYRROLIDONE. H. Huegli and H. R. von Gunten (Switzerland. Eidgenössisches Institut für Reaktorforschung, Würenlingen). Sept. 1963. 14p.

A modification of the Gordon method for labeling polyvinylpyrrolidone with I^{131} is described. Some properties of a relatively stable product with a high iodine content are discussed. (auth)

10116 (EUR-412.f) RECHERCHES SUR LA PRÉPARATION ET LA CONSERVATION DES STÉROIDES TRITIÉS D'ACTIVITÉ SPÉCIFIQUE ÉLEVÉE. (Research on the Preparation and Conservation of Tritiated Steroids with High Specific Activity). P. Osinski (Institut Interuniversitaire des Sciences Nucléaires, Brussels). 1963. 12p.

Study of the synthesis of 3 artificial steroids by dehydrogenation with selenium dioxide has shown that the yield is increased by a factor of between 2.5 and 4 by doubling the quantity of the catalyst. The maximum possible specific activity is equal to ⅓ of the activity incorporated at the time of hydrogenation, i.e., 40 C/mM. The decrease in specific activity is due to the loss of the isotope during dehydrogenation. A study has been carried out on the synthesis of 3 natural corticosteroids by enzymatic reduction or chemical reduction. The storage behavior of cortisol-1,2-H^3 and of corticosterone-1,2-H^3 having high specific activities shows that there are two self-irradiation destruction mechanisms according to the type of solvent. The organic solvents make for the formation of impurities of polarities similar to the starting substance. Water promotes the formation of a polar fraction. Good storage is ensured by the use of a cyclical solvent of little reactivity at low temperature. (auth)

10117 (EUR-492.d) SYNTHESE VON KOHLENSTOFF-14-, TRITIUM- UND DEUTERIUM-MARKIERTEN TERPHENYLEN. (Synthesis of Terphenyls Labelled with Carbon-14, Tritium and Deuterium). (Battelle Institute e. V., Frankfurt am Main). 1963. 44p.

Methods for the preparation of C^{14}- and tritium-labeled terphenyls are indicated. The conversion of 2-, 3- and 4-phenylcyclohexanone or -hexenone with tritium-substituted phenylmagnesium bromide is described as being promising with regard to simplicity of synthesis method and end products to yield for the preparation of terphenyls tritium-labeled at the terminal ring. In the same way, the reaction of 2-, 3- and 4-bromocyclohexanone or -hexanone with phenylmagnesium bromide should lead to the desired result. For the preparation of terphenyls tritium-labeled at the central ring, consideration is given to similar conversions of labeled cyclohexadione of bromocyclohexadione with phenylmagnesium bromide or phenyllithium. For the preparation of terphenyls labeled with C^{14} at the terminal and central rings, consideration is given to similar conversions of phenylcyclohexanone with phenyllithium or phenylmagnesium bromide and to the reaction of the Grignard compounds of dibromobenzene with cyclohexanone. (auth)

10118 (ORNL-TM-777) SYNTHESIS OF METHYL ISOCYANIDE. H. L. Holsopple (Oak Ridge National Lab., Tenn.). Jan. 27, 1964. Contract [W-7405-eng-26]. 6p.

The preparation of essentially pure methyl isocyanide is described. The compound was prepared by decomposing a solid complex of methyl iodide and silver cyanide with an aqueous potassium cyanide solution. Methyl isocyanide was separated by distillation through a packed column and purified by passing the vapors, under vacuum, through appropriate contaminant-removing reagents. (auth)

10119 (NP-tr-1093) STUDIES ON TRITIUM-LABELLED COMPOUNDS. PREPARATION OF TRITIUM-LABELLED ESSENTIAL AMINO ACIDS. Paper No. 5. Y. Satō and T. Takahashi. Translated by S. G. Brickley (U.K.A.E.A., Atomic Energy Research Establishment, Harwell, Berks, England), from Radioisotopes (Tokyo), 10: 488-92(1961). 15p.

The gas-exposure method, discharge method, and chemical reduction method were used for the tritium labeling of a number of amino acids. The following were labeled: phenylalanine, isoleucine, valine, leucine, tryptophane, lysine, methionine, and threonine. The methods are compared. (D.L.C.)

10120 CALCULATIONS OF SULPHUR AND NITROGEN ISOTOPE EFFECTS. W. H. Saunders, Jr. (Univ. of Rochester, N. Y.). Chem. Ind. (London), No. 41, 1661-2(Oct. 12, 1963).

Isotope effects in Me_3S^+ and Me_4N^+ (where Me is methyl) were studied. The fundamental vibrational frequencies of each pair of isotope reactants and activated complexes were calculated by the Wilson FG matrix method. Kinetic isotope effects were calculated with the Bigeleisen equation. (M.C.G.)

10121 SYNTHESIS OF TESTOSTERONE-19-^{14}C. P. Narasimha Rao and L. R. Axelrod (Southwest Foundation for Research and Education, San Antonio). Chem. Ind. (London), No. 46, 1838-9(Nov. 16, 1963).

The preparation of testosterone labeled with C^{14} at the C(19) group is described. The yield was 4%. (M.C.G.)

10122 PREPARATION OF LABELLED OLEFINS BY TRITIOBORATION PROCEDURES. Nguyen H. Nam, A. J. Russo, and R. F. Nystrom (Univ. of Illinois, Urbana). Chem. Ind. (London), No. 47, 1876-7(Nov. 23, 1963).

The preparation of tritium-labeled 1-hexene and cyclohexene by application of various hydroboration reactions is described. The position of labeling was established by degradation. (M.C.G.)

10123 A METHOD FOR THE RADIOACTIVE LABELLING OF SILICONE OILS WITH ^{131}I. J. A. Moss (British Leather Mfr. Research Assn., Egham, Surrey, Eng.). Chem. Ind. (London), No. 50, 1952-3(Dec. 14, 1963).

Iodination and bromination of the methyl groups of silicone oils in the presence of ultraviolet light were attempted without success. An exchange labeling process involving chlorination of the methyl group in the presence of ultraviolet light followed by exchange with I^{131} was found to be satisfactory. (M.C.G.)

10124 COMPLEXES OF THE TRIVALENT RARE EARTHS WITH ISOBUTYRATE, α-HYDROXYISOBUTYRATE, AND α,β,β'-TRIHYDROXYISOBUTYRATE LIGANDS. W. R. Stagg and J. E. Powell (Ames Lab., Ames, Iowa). Inorg. Chem., 3: 242-5(Feb. 1964). (IS-679)

Complexes of the trivalent rare earths with the ligands isobutyrate, α-hydroxyisobutyrate, and α,β,β'-trihydroxyisobutyrate were studied at 25°C and an ionic strength of 0.5 M. The isobutyrate complexes were very weak compared to the other two series of complexes. It was found that the α-hydroxyisobutyrate complexes were less stable than the corresponding α,β,β'-trihydroxyisobutyrate complexes of the light rare earths, but the relative stabilities were reversed for the heavier rare earths. It was postulated that a change in coordination of the α,β,β'-trihydroxyisobutyrate ligand was responsible for the inversion. (auth)

10125 INFRARED SPECTRA OF $SiH_3C \equiv CH$ AND $SiD_3C \equiv CH$. R. B. Reeves, R. E. Wilde, and D. W. Robinson (Johns Hopkins Univ., Baltimore). J. Chem. Phys., 40: 125-31(Jan. 1, 1964).

Low-resolution infrared studies of silylacetylene and silylacetylene-d_3 enabled the fundamental vibrational frequencies to be assigned to normal modes of motion. Also, many of the overtone and combination bands were tentatively assigned. Argon-matrix spectra at 4.2°K were helpful in assigning nearly degenerate vibrations, particularly the Si–C stretching motion. Medium-resolution spectra enabled approximate values to be obtained for the band origins and Coriolis coupling constants of most of the perpendicular-type fundamentals. (auth)

10126 SPECTROPHOTOMETRIC STUDIES OF DIOXO-COMPLEXES OF QUADRIVALENT METALS. I. COMPLEXES OF ZIRCONIUM AND HAFNIUM WITH PYROGALLOLSULFONEPHTHALEIN. Kuan Pan, Zui-Feng Lin, Sheng-Hsien Lin, Yu-Lin Wu, and Eng-Ming Chen (National Taiwan Univ., China). J. Chinese Chem. Soc. (Taiwan) (2), 10: 24-32(Mar. 31, 1963).

Pyrogallolsulfonephthalein and its complexes with zirconium and hafnium were spectrophotometrically studied in $HClO_4$ and $NaClO_4$ solutions of various pH's. An absorption maximum at 472 mμ was found for pyrogallolsulfonephthalein at pH 1.0 and 1.5. It shifts to 518 and 520 mμ in the presence of zirconium at pH 1.0 and hafnium at pH 1.5, respectively. The mole ratios of both metals to the dye were found to be 1:1, and the apparent instability constants of the complexes were estimated as 1.34×10^{-5} for the former and 7.06×10^{-6} for the latter. (auth)

10127 CATHODIC ACTION OF THE METAL COMPLEXES AT THE DROPPING MERCURY ELECTRODE. VIII. URANYL-GLYCINATE COMPLEX. Tsai-Teh Lai, Han-Ton Lin, and Ching-Chiang Hsieh (Cheng Kung Univ., Tainan, Taiwan, China). J. Chinese Chem. Soc. (Taiwan) (2), 10: 33-40(Mar. 31, 1963).

The formation of complex between uranyl ion and glycine was investigated by the polarographic method. Reversible and diffusion-controlled reduction waves were observed over the pH range 1.7 to 5.0 when the glycinate concentration was 0.049 to 0.393 M. The effect of pH and the concentration of chelating agent on the half-wave potential was determined. The chelate species and the electrode reactions were established. (auth)

10128 RADIOCHEMICAL INVESTIGATION OF POLYMER UNSATURATION. REACTION OF BUTYL RUBBER WITH RADIOCHLORINE. I. C. McNeill (Univ. of Durham, Eng.). Polymer, 4: 15-25(Mar. 1963).

By the use of (Cl^{36})-chlorine, studies were made on the reaction between chlorine and butyl rubber on a conveniently small scale, the radiochlorine being manipulated quantitatively by a vacuum line technique. It is shown that the reaction with chlorine is freer from side effects than the iodine chloride reaction. Two atoms of chlorine are incorporated in the polymer for each double bond originally present. These are incorporated not by addition but by a substitution process, which is probably not free-radical in nature. A mechanism is proposed for the reaction. Radiochlorine is demonstrated to be potentially a useful reagent for investigating very low unsaturations in polymers. (P.C.H.)

10129 THE KINETIC ISOTOPE EFFECT IN THE PHOTOCHLORINATION OF METHANE. K. B. Wiberg and E. L. Motell (Yale Univ., New Haven). Tetrahedron, 19: 2009-23(Dec. 1963).

The kinetic isotope effect for the photochemically initiated chlorination of methane-d_2 was determined. The value is $k_H/k_D = 12.1$ at 0°C, and the variation with temperature is given by $k_H/k_D = 1.09 \exp(1300/RT)$. The results are considered in terms of a semiempirical potential energy surface, and the general subject of the magnitudes of primary kinetic isotope effects is discussed. (auth)

10130 A KINETIC ISOTOPE EFFECT IN THE TRICYANOVINYLATION OF DIMETHYLANILINE. P. G. Farrell and J. Newton (Sir John Cass Coll., London). Tetrahedron Letters, No. 3, 189-92(Jan. 1964).

A kinetic isotope effect was observed in the rate of formation of the final product of the reaction between tricyanoethylene and dimethylaniline and its deutero-derivatives that was consistent with the mechanism proposed by Rapoport (J. Chem. Soc., 4498, 1963)). Investigations of the mechanism of reactions between dialkylanilines and tritcyanoethylene showed that the formation of a charge-transfer complex between the free base and tritcyanoethylene is not essential to the formation of the θ-complex, but that in organic solvents some charge-transfer complex formation is always observed. The electron-donating ability of the dialkylanilines was measured. (M.C.G.)

10131 INVESTIGATION OF COMPLEX FORMATION IN THE SYSTEM ZIRCONIUM–DIANTIPYRILMETHANE–THIOCYANATE. M. M. Tananaiko (Kiev State Univ.). Ukr. Khim. Zh., 29: 566-71(1963). (In Russian)

Complexing of zirconium–diantipyrinemethane–thiocyanates in solution was studied, and the formation of an easily extracted zirconium–diantipyrilmethane–thiocyanate complex was verified. Optimum conditions for the formation and extraction were found with 2 M HCl, 0.02 M diantipyrilmethane, and 0.5 M ammonium thiocyanates. Physico-chemical analysis indicated the formula $(Diant\ H)_2$

$[Zr(SCN)_8]$. The effects of ethanol and acetone on complex formation were examined. (R.V.J.)

10132 OBTAINING VINYL ESTERS LABELLED WITH O^{18}. L. A. Kiprianova and A. F. Rekasheva (Pisarzhevskii Inst. of Physical Chemistry, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 29: 1064-6(1963). (In Russian)

Two methods are suggested for preparing vinyl esters labeled with O^{18}. Esters with O^{18} distributed equally between the two oxygen atoms of the carboxyl group were prepared by exchange reactions between ordinary vinyl acetate and labeled acid. Introduction of O^{18} into the ester oxygen only was achieved by reacting labeled chloromercuroacetaldehyde with carbonic acid chloroanhydride. The result confirmed that the reaction follows O-acetylation of α-chloromercuroacetaldehyde and does not form intermediate compounds with equivalent oxygen atoms. (R.V.J.)

10133 APPLICATION OF MULTILABELED COMPOUNDS IN STUDIES OF ISOTOPIC EXCHANGE OF ANTIMONY IN ITS METHYL DERIVATIVES. V. D. Nefedov, I. S. Kirin, V. M. Zaitsev, G. A. Semenov, and B. E. Dzevitskii. Zh. Obshch. Khim., 33: 2407-10(July 1963). (In Russian)

Electron mechanisms in antimony isotope exchange in $Sb(CH_3)_3-Sb(CH_3)_3Cl-$alcohol was investigated by means of labeled compounds. The studies revealed a slow exchange of radicals. (R.V.J.)

10134 ISOTOPIC EXCHANGE OF HYDROGEN IN METHYL DERIVATIVES OF NITRIC HETEROCYCLES AND THEIR N-OXIDES. I. PICOLINE, QUINALDINE AND THEIR N-OXIDES. N. N. Zatsepina, I. F. Tupitsyn, and L. S. Efros. Zh. Obshch. Khim., 33: 2705-12(Aug. 1963). (In Russian)

Studies of hydrogen exchange in α-picoline, quinaldine methyl groups and their n-oxides showed that hydrogen mobility increases from α-picoline to quinaldine and from heterocycles to n-oxides. Triethylamine and piperidine do not catalyze the reaction, while alcoholate ions have strong catalytic effects. The kinetic isotopic effect for exchange in α-picoline n-oxide is equal to 2.2 ± 0.2. It was postulated that hydrogen exchange limits complete C–H bond breakage. (R.V.J.)

10135 IZOTOPY V ORGANICHESKOI KHIMII. OBRABOTKA I DOPOLNENIYA KANDIDATOV KHEMICHESKIKH NAUK I. P. GRAGEROVA I A. F. REKASHEVOI. (Isotopes in Organic Chemistry. Developed and Expanded by I. P. Gragerova and A. F. Rekashevoi). G. P. Miklukhii. Kiev, Publishing House of the Ukrainian SSR Academy of Sciences, 1961. 731p.

Systematic data are given from investigations in organic chemistry using isotopic tracers. Results from 3000 studies on synthesis, labeling, isotopic exchange, and reaction mechanisms are given. (R.V.J.)

10136 RATE OF TRITIUM EXCHANGE IN DIETHYL METHYL-d_3-MALONATE-t AND DIETHYL MALONATE-d,t IN BUFFERED AQUEOUS SOLUTIONS. O. Gjurović-Deletis, S. Borčić, and D. E. Sunko (Institut "Rudjer Bošković", Zagreb). Vienna, International Atomic Energy Agency, 1963, Preprint SM-50/46, 11p. (CONF-269-3)

From International Atomic Energy Agency Symposium on Isotope Mass Effects in Chemistry and Biology, Vienna, Dec. 1963.

Residual acidic hydrogen was partly substituted for tritium in diethyl methyl malonate and the methyl-deuteriated analogue. The labeled compounds then underwent the exchange of tritium for protium in buffered aqueous solutions at constant temperature. The rate of exchange was followed by extracting the organic substance in definite time intervals and measuring the activity drop of the samples. The results show that, within the limits of error, the rate of exchange of tritium for protium in both cases is the same; the vicinal deuterium, in respect to the acidic tritium, does not affect the reaction rate. The investigation was then extended to the diethyl malonate. Diethyl malonate-t and diethyl malonate-d,t were prepared in an analogous manner and their rate of tritium exchange was measured in buffered aqueous and deuterium oxide solutions, respectively. The observed rate constants for the deuterated and non-deuterated ester ($k \cdot 10^4 \cdot sec^{-1}$, 25°) were 1.35 and 13.86, respectively. (P.C.H.)

10137 THE EFFECT OF DEUTERIUM SUBSTITUTION ON THE SOLVOLYSIS RATES OF (METHYLCYCLOPROPYL)-CARBINYL DERIVATIVES. M. Nikoletić, S. Borčić, and D. E. Sunko (Institut "Rudjer Bošković", Zagreb). Vienna, International Atomic Energy Agency, 1963, Preprint SM-50/45, 15p. (CONF-269-4)

From International Atomic Energy Agency Symposium on Isotope Mass Effects in Chemistry and Biology, Vienna, Dec. 1963.

The pronounced rate enhancements observed in the solvolysis of cyclopropylcarbinyl derivatives and the extensive rearrangements that occur in the reactions were interpreted by assuming the formation in the rate-determining step of a non-classical bicyclobutonium ion. Methyl- and methyl-d_3-substituted cyclopropylcarbinyl derivatives were prepared and their solvolysis rates measured. For a number of the derivatives rate constants were determined in 96% ethanol. The results were surprising because: in no case was a secondary kinetic isotope effect observed; the introduction of a methyl group produced only a five-fold rate enhancement; and a considerable rate increase (100 times) was caused by gem-methyl groups. (P.C.H.)

10138 TRITIUM AND DEUTERIUM ARRHENIUS PARAMETER EFFECTS IN A BASE PROMOTED ELIMINATION REACTION. EVIDENCE FOR TUNNELLING. V. J. Shiner, Jr. and B. Martin (Indiana Univ., Bloomington). Vienna, International Atomic Energy Agency, 1963, Preprint SM-50/20, 19p. (CONF-269-7)

From International Atomic Energy Agency Symposium on Isotope Mass Effects in Chemistry and Biology, Vienna, Dec. 1963.

The ratio of the rate of reaction of 1-bromo-2-phenylpropane-2-d to that of the 2-tritio analog with sodium ethoxide in dry ethanol was determined by a competitive technique at 25, 45, and 65°C. α-Methylstyrene was not the sole product of the reaction; side reactions of the 2-tritio compound producing 12 to 13% of 1 ethoxy-2-phenylpropane-2-t and β-methyl-β-t-styrene were detected. The Arrhenius parameters for the elimination reaction of the 2-deuterio and 2-tritio compounds were determined. The Arrhenius equation is $\log(k_D/k_T) = -0.0744 + (680/2.303\ RT)$. The activation energy difference is in excess of that predicted from the difference in zero point energies of the calculated ground state vibrational frequencies (478 cal/mole), but the ratio of the frequency factors (1.19) is much closer to unity. The data lead to the conclusion that there is non-classical tunnelling through the energy barrier by the proton, and possibly to a small extent by the deuteron. Some loss in the activated complex of zero point energy of the vibrational bending modes of the breaking bond is indicated. (P.C.H.)

Radiation Chemistry and Radiochemistry

10139 (AD-403358) EFFECTS OF IONIZING RADIATIONS ON AQUEOUS SOLUTIONS OF FORMIC AND OXALIC ACID. Final Technical Report, November 1, 1961–November 1, 1962. Joseph J. Weiss (King's Coll., Newcastle upon Tyne, England). Contract DA-91-591-EUC-1977. 26p.

In aqueous solutions CO_2 and bicarbonate react with negatively charged polarons (H_2O)– formed by the gamma irradiation of water, leading to formation of the carboxyl radical ion. In the presence of organic solutes, the carboxyl radical ion may add on to other free radicals, e.g., those formed by the action of radiation-produced OH radicals on organic solutes, to give the corresponding carboxylic acids. Using C^{14} labeled carbon dioxide or bicarbonate, this process could provide a method for the production of carboxylic acids labeled in the carboxyl group. In neutral solutions two reducing species, i.e., negative polarons and primarily formed H atoms, were shown to be present in irradiated water; their reactions with various solutes were studied. All irradiations were carried out with Co^{60} gamma rays. For irradiation of aqueous solutions in the presence and absence of different gases (O_2, CO_2, N_2O) standard irradiation techniques were used. Analysis of the gaseous irradiation products was carried out by means of the mass-spectrometer. Other irradiation products were determined spectrophotometrically or by radioactive tracer techniques. (auth)

10140 (UJV-969/63) LOCALIZATION OF ENERGY IN THE RADIOLYSIS OF SOLUTIONS. PART II. POSSIBLE ROLE OF ELECTRONIC EXCITATION SPECTRA. J. Bednář (Československá Akademie ved. Ustav Jaderneho Vyzhumu, Řež). [196?]. 16p.

A discussion is presented of some factors which may cause the absorbed radiation energy to appear on a single molecule or an isolated group of molecules in an early stage of radiolysis. The process of energy localization is shown to be connected with the electronic spectra of mixtures. The distribution of energy in mixtures is considered. The relation of the excitation spectra to experimental radiolytic data is discussed using hydrogen yields. (D.L.C.)

10141 (USNRDL-TR-691) GAMMA RADIATION EFFECTS ON ISOPRENOIDS. II. 2,6-DIMETHYLOCTANE AND 2,6-DIMETHYLOCTADIENE-2,6. W. E. Shelberg (Naval Radiological Defense Lab., San Francisco). Sept. 20, 1963. 29p.

The radiolytic decomposition of 2,6-dimethyloctadiene-2,6 and 2,6-dimethyloctane, respectively, models for rubber and hydro-rubber, was investigated. Yields of hydrogen gas and hydrocarbons through C_5 were determined at low conversions. For both models, hydrogen gas was attributed to abstractions by "hot" and lesser energetic hydrogen atoms and to hydrogen molecule detachments. Nineteen hydrocarbon products were found for the diene and twenty for the paraffin. Yields from the diene are generally smaller than those from the paraffin. The formation of hydrocarbon products from the diene is interpreted by means of radical reactions involving little or no diffusion. The formation of hydrocarbon products from the paraffin is interpreted by means of radical reactions involving caging as well as free diffusion. (auth)

10142 DEPENDENCE OF IONIZATION CURRENT IN SATURATED HYDRO-CARBON LIQUIDS ON RADIATION ENERGY. Andrzej Januszajtis (Technical Univ. of Danzig). Acta Phys. Polon., 24: 809-16(Dec. 1963).

The dependence of hexane-to-air ratio of ionization currents in an ionization chamber on x and gamma ray energy is discussed. The results of the measurements carried out by means of a chamber with coplanar electrodes are in good agreement with the theoretical curve drawn on the assumption that the effectiveness of ion collecting, corresponding to the extrapolated saturation current, does not depend on radiation energy and is equal to 2.3%. Obtained results cannot be explained in terms of the theories of Jaffé and Kramers. (auth)

10143 RADIATION CHEMISTRY. P. J. Dyne, D. R. Smith, and J. A. Stone (Atomic Energy of Canada Ltd., Chalk River, Ont.). Ann. Rev. Phys. Chem., 14: 313-34 (1963).

A review is presented on the reactions of intermediates and the chemical mechanism of radiolytic decomposition. 159 references are included. (P.C.H.)

10144 RADIATION CHEMISTRY OF OXYANIONS OF TRANSITION ELEMENTS. III. REDUCTION OF MANGANATE AND HYPOMANGANATE IN CONCENTRATED KOH AND NaOH SOLUTIONS BY ^{60}Co γ RAYS. J. Kaleciński and B. Jezowska-Trzebiatowska (Inst. of Physical Chemistry, Polish Academy of Sciences, Wroclaw). Bull. Acad. Polon Sci., Ser. Sci. Chim., 11: 531-7(1963).

The yields and mechanisms of reduction of manganate and hypomanganate in concentrated KOH and NaOH solutions are investigated to obtain a general idea of the mechanism of radiolysis of concentrated alkali solutions. (C.E.S.)

10145 THE RATE OF IODINATION OF ANILINE AND THE EFFECT OF BACKGROUND RADIATION ENERGY. Nganshou Wai and Sheau-Jean Yao. Bull. Inst. Chem. Acad. Sinica, No. 8, 1-11(Oct. 1963).

After the lapse of the same time and under the same conditions, the rate constant of the iodination of aniline measured from a stock solution stored in a wooden box was lower than that in a lead box. It may be predicted that the ordinary background radiation energy, such as cosmic rays on the sea level, contributes to the deceleration of the iodination reaction. During the iodination of aniline, the concentration of iodine measured from a series of experiments conducted under three different conditions were found to be in the order: irradiated with radioactive compound > stored in wooden box > stored in lead box. (auth)

10146 ELECTROKINETICS OF VANADIUM PENTOXIDE SOL AFFECTED BY X-RAY IRRADIATION. Huh-Sheng Tsuei and Nganshou Wai. Bull. Inst. Chem. Acad. Sinica, No. 8, 33-41(Oct. 1963).

A microscopic method for measuring zeta-potential of vanadium pentoxide sol is described. The irradiation of x rays on the sol resulted in the decrease of zeta potential and increase in the specific conductivity of the sol system. Beyond a certain dose, about 10^4 roentgens per ml, the vanadium pentoxide sol began to coagulate. Precautions against the troubles encountered in the experiment were enumerated. (auth)

10147 ASTATINE. Clément Duval. Chim. Anal. (Paris), 45: 557-9(Nov. 1963). (In French)

The chemical and analytic properties of At are reviewed. The properties of the nuclides from At^{200} to At^{219} are included. Data on preparation and determination are also noted. (T.F.H.)

10148 ON INTERPRETATION OF EPR SPECTRUM OF FREE RADICALS IN γ-IRRADIATED METHANOL. R. Lenk (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Řež). Czech. J. Phys., 13: 841-5(1963).

The values of the hyperfine splitting constants of the EPR spectrum in γ-irradiated methanol at 77°K is calculated as

a function of the valence angle H–C–H in a CH_2 fragment. The comparison of the experimental and calculated values of the hyperfine splitting constant and a discussion of the possible valence angles leads to the conclusion that the EPR spectrum in irradiated methanol originates from the radical $\dot{C}H_2OH$. (auth)

10149 ENERGY TRANSFER IN THE RADIATION OXIDATION OF AROMATIC HYDROCARBONS. A. T. Koritskii and V. N. Shamshev (Inst. of Chemical Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 153: 111-13 (Nov. 1, 1963). (In Russian)

Peroxides take an active part in the radiation oxidation of hydrocarbons. The total radical yield was determined by electron paramagnetic resonance (EPR) on irradiating cumene (isopropylbenzene) in the presence of varying amounts of cumene hydroperoxide (CHP). At low concentrations, an addition of about 5×10^{-3} mols/l of cumene hydroperoxide increased the rate of radical formation in cumene by a factor of about 2.5. The presence of a small amount of cumene hydroperoxide on irradiation leads to the appearance of an unsymmetrical signal that is characteristic of peroxy radicals formed from the breakdown of a ROOH compound. The thermal oxidation of a condensed hydrocarbon takes place by a chain mechanism with degenerate branching. The chain is initiated by the reaction: $(RH)^* \rightarrow R^{\cdot} + H^{\cdot}$. It propagates by the reactions: $R^{\cdot} + O_2 \rightarrow RO_2$ and $RO_2 + RH \rightarrow ROOH + R^{\cdot}$ etc. Branching takes place by the reaction: $(ROOH)^* \rightarrow RO^{\cdot} + H^{\cdot}$. The chain is terminated by reactions of the following type: $R^{\cdot} + R^{\cdot}$, $RO_2^{\cdot} + RO_2^{\cdot}$, and $R^{\cdot} + RO_2^{\cdot}$. The data do not clearly indicate the energy transfer mechanism. (TTT)

10150 PHOTO REACTIONS OF MAGNESIUM PHTHALOCYANINE WITH THE COORDINATING URANYL CATION. G. I. Kobyshev, G. N. Lyalin, and A. N. Terenin (Leningrad State Univ.). Dokl. Akad. Nauk SSSR, 153: 865-8(Dec. 1, 1963). (In Russian)

Binary solutions of 10^{-5} M magnesium phthalocyanine (Mgphcy) and 10^{-3} M UO_2^{2+} (nitrate) in pyridine were irradiated in air at room temperature with light of 340-390 mμ. The intensity of the Mgphcy red (675 mμ) fluorescence decreased continuously and rapidly with irradiation time. The drop ceased when the irradiation was stopped. The intensity of the uranyl luminescence also decreased irreversibly. The velocity of the photoreaction, which consists in formation between the excited UO_2^{2+} and the Mgphcy molecules of a compound similar to the end product, increased with increasing UO_2^{2+} concentration. The intensity also decreased when the irradiation was with only that light absorbed by the Mgphcy. When the irradiation was stopped, the intensity of the luminescence returned to its original value, and the light-dark cycle was carried out several times without change. This phenomenon occurred only in the presence of the uranyl ion and was observed also in ethanol and acetone. Here only the Mgphcy was excited, with which the uranyl ion acts in the ground state; i.e., the luminescence is quenched at a rate comparable with the reverse, nonluminescent, process. Such a rapid reversal of the reaction is compatible with the existence of electron exchange. In a similar irradiation in ethanol at 90°K, the luminescence and absorption spectrum of the red pigment disappeared and an absorption band appeared at 530 mμ. The uranyl ion here appears to photodehydrogenate the ethanol and cause transfer of hydrogen to Mgphcy. Irradiation at 290°K with wavelengths longer than 600 mμ showed a weak absorption maximum at 700 mμ; but when the solution was further cross-irradiated with focused light through a filter separating the lines at 430 mμ, a strong maximum appeared at 700 mμ but disappeared when the supplementary irradiation was stopped. (TTT)

10151 RADIATION CHEMISTRY OF HYDROCARBONS. 7. IODINE IN HEXANE. Hans Widmer and Tino Gaeumann (Eidgenossische Technische Hochschule, Zurich). Helv. Chim. Acta, 46: 2766-80(1963). (In German)

The radiolysis of hexane was studied as a function of temperature and dose. Iodine was used as a scavenger to distinguish between radical and molecular reactions. The G values of the molecular reactions are independent of temperature, but the sum of the products from radical reactions increases with temperature. This means that the over-all decomposition of hexane has a positive temperature coefficient. A temperature-independent probability for primary bond fission, forming either radicals or molecular products, was calculated. (auth)

10152 RADIATION CHEMISTRY OF HYDROCARBONS. 8. OLEFINS IN HEXANE. Hans Widmer and Tino Gaeumann (Eidgenossische Technische Hochschule, Zurich). Helv. Chim. Acta, 46: 2780-7(1963). (In German)

The radiation chemistry of solutions of olefins in hexane was studied as a function of temperature. Activation energies of 5.5 kcal/mole and 6.8 kcal/mole were found for the addition of alkyl radicals to 1-hexene and 1-octene, respectively. The addition of hydrogen atoms to olefins does not show the expected temperature dependence; olefins apparently also reduce the number of radicals formed or available. The reason for this unexpected behavior is not clear. (auth)

10153 RADIATION CHEMISTRY OF HYDROCARBONS. 9. BENZENE. Tino Gaeumann (Eidgenossische Technische Hochschule, Zurich). Helv. Chim. Acta, 46: 2873-85(1963). (In German)

Some radiolytic products in heavy and light benzene and their mixtures were determined as a function of temperature and additives. Most of the results can be explained in terms of radical reactions, but evidence is given that other mechanisms must take part. (auth)

10154 OPTICAL ABSORPTION IN IRRADIATED SODIUM BROMATE CRYSTALS. C. Ramasastry and Y. V. G. S. Murti (Indian Inst. of Tech., Madras). Indian J. Pure Appl. Phys., 2: 35-6(Jan. 1964).

The changes in the optical absorption of sodium bromate crystals due to x irradiation were studied. The absorption spectrum of the irradiated crystal consists of three bands with peaks located at 280, 330, and 420 mμ. The 330 mμ band corresponds to BrO^- formed by radiolysis. The 280 mμ band is interpreted as a charge transfer peak of BrO_3^- modified by the presence of BrO^- ions in the neighborhood. The 420 mμ band is tentatively attributed to molecular bromine or any non-magnetic oxide of bromine. (auth)

10155 MASS-SPECTROMETRIC STUDIES OF RADIOLYSIS OF POLYMERS WITH CONJUGATE BONDS. G. K. Vasil'ev and V. L. Tal'roze (Inst. of Chemical Physics, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 12, 2124-31(Dec. 1963). (In Russian)

A high-sensitivity mass spectroscopic method was developed for determining the composition and kinetics of gaseous products produced in the radiolysis of organic compounds. The method is capable of measuring gaseous yields of 0.002 to 0.001 molecules/100 ev. Radiolysis of conjugate polymer systems was studied, and the basic products of (H and CO_2) were analyzed. Separation of CO_2 in radiolysis indicated a negligible energy transmission to oxygen-containing groups. (R.V.J.)

10156 FLUORESCENT YIELD IN THE PHOSPHOR NE-102 FOR X RAYS FROM 4 TO 17 kev. L. Evan Bailey (Stanford Research Inst., Menlo Park, Calif.). J. Appl. Phys., 34: 3008-9(Oct. 1963).

The measured light output per absorbed x-ray photon of the plastic phosphor NE-102 in the 4- to 17-kev range of x-ray energy fits a straight line with a positive intercept of 1.44 kev. (auth)

10157 RADIOLYSIS OF SIMPLE AROMATICS IN BORIC ACID GLASS. Floyd Hughes, Russell D. Kirk, and Frank W. Patten (Naval Research Lab., Washington, D. C.). J. Chem. Phys., 40: 872-6 (Feb. 1, 1964).

Electron paramagnetic resonance studies were made of the stable free radicals produced by x irradiation of aromatic hydrocarbons dissolved in partially dehydrated boric acid glass. In general, singly charged molecular ions were not found to be the sole species. Deuterium substitution in the boric acid glass showed that all end point radicals contained hydrogen from the matrix. All glasses exhibited a 100–140 G EPR pattern, which was interpreted as that of radicals produced by formation of a $-CH_2-$ group in a benzene ring. (auth)

10158 GAMMA-RADIATION INDUCED CONDUCTANCE OF LIQUID HYDROCARBONS AT LOW VOLTAGES. G. R. Freeman (Univ. of Alberta, Edmonton). J. Chem. Phys., 40: 907(Feb. 1, 1964).

Studies were made on the radioinduced conductance of liquid cyclohexane at a dose rate of 1.20×10^{15} ev/ml sec. The effective counter-voltage increased slowly with increasing resistance of the circuit, over a certain range (6 mv across 5×10^7 Ω and about 1 v across 10^{11} Ω), but was negligible at resistances as great as that of the cyclohexane-filled conductance cell in the absence of radiation (>10^{16} Ω). Thus the voltage intercept is not due to irradiation of the lead-in wires. It was concluded that a decrease at low field strengths does not exist, and the effect of electric field strength on conductance can be explained over the entire range from 1 v/cm to about 7×10^4 v/cm. (P.C.H.)

10159 PAPER ELECTROCHROMATOGRAPHIC STUDIES OF SOME RADIOISOTOPES. Kuan Pan and Hwasheng Cheng (National Taiwan Univ., Taipai, China). J. Chinese Chem. Soc. (Taiwan), 7: 103-31(Dec. 1960).

The mobilities of Co^{60}, Sr^{90}, Y^{90}, Cs^{134}, Ce^{144} and Eu^{152} ($+Eu^{154}$), as a function of pH in 1% citric acid solutions of their carrier-free chlorides, were studied. Cesium ion, which migrated toward the cathode, decreased in mobility linearly as the pH increased. Strontium ion had an electromigration behavior similar to that of Cs ion up to pH 5 then changed the direction of migration toward the anode at pH 4.5; Co and rare earth ions, having a similar behavior, changed their ionic charge at pH 2.2 and 3.2, respectively. By taking advantage of this behavior, Cs could be separated from bi- and tervalent metal ions at any pH values, whereas Y could be separated from Sr ions, and rare earth from Co ions only at low pH values. The separation of Y^{90} from Sr^{90} was effectively carried out in an 80% alcoholic solution of citric acid. After electrophoresis for 2 hr, Sr migrated 20 cm while Y moved only 2 cm. Cerium and Eu behave similarly to Y. Their migration distances decreased with increasing pH values; they changed their ionic charge at pH 2.7, migrated toward the anode, and then their mobility gradually decreased above pH 5. At higher pH values in the acid region, however, Eu showed slightly greater velocity than Ce. This slight difference may be useful in the separation of Ce, Eu, and Y at higher field strengths and prolonged times of operation. Although the radioactivity maxima of Ce and Eu separate by 1 cm from each other, these rare earths diffuse widely to about 4 cm on the paper strips; therefore, quantitative separation of these 2 metals under the present experimental conditions was not possible. The short-lived Pr^{144} could not be detected in the electrochromatograms of Ce^{144}, because the daughter decayed almost completely as soon as it is separated. It is reasonable to expect that Pr would be located between Ce and Eu. (BBB)

10160 EFFECTS OF IONIZING RADIATION ON OXIDATION-REDUCTION TRANSFORMATIONS OF ACCEPTORS IN ORGANIC SOLVENTS. III. REDUCTION OF PERMANGANATE IONS IN ACETONE SOLUTIONS. L. T. Bugaenko, M. F. Romantsev, and N. A. Bakh (Moscow State Univ.). Kinetika i Kataliz, 4: 811-14(Nov.-Dec. 1963). (In Russian)

Radiochemical transformations of permanganate ions in acetone solutions were analyzed. Permanganate radioreduced to manganese dioxide exhibited an increased yield with increased permanganate concentrations and reached 23 equiv/100 ev in 0.002 M solution. A reduced post-irradiation yield was observed with increased permanganate concentration. The total reduction yield increased with increased permanganate concentration, reaching 42 equiv/100 ev in 0.002 M solution. The mechanism of permanganate reduction in reactions with acetone radiolysis products was analyzed. (R.V.J.)

10161 RADIATION OXIDATION OF TWO-PHASE HYDROCARBON–WATER SYSTEMS. V. V. Saraeva and Yu-tai Chin (Moscow State Univ.). Kinetika i Kataliz, 4: 823-8(Nov.-Dec. 1963). (In Russian)

Investigations of radio-oxidation of two-phase heptane-water systems indicate that with small additions of peroxides, carbonyl compounds, acids, and alcohols the yields are equal to the sum of the yields in separately irradiated phases. In aqueous solutions the acid yield exceeds the acid yield produced in pure heptane. (R.V.J.)

10162 RADIOLYSIS OF AQUEOUS NEUTRAL SOLUTIONS OF NITRATES AT HIGH ABSORBED DOSES. A. K. Pikaev, P. Ya. Glazunov, and A. A. Yakubovich (Inst. of Physical Chemistry, Academy of Sciences, USSR). Kinetika i Kataliz, 4: 835-43(Nov.-Dec. 1963). (In Russian)

Radiolysis of neutral aqueous $NaNO_3$ solutions was analyzed for a wide range of concentrations and doses. Effects of pulsed electron irradiation on NO_2^- yields from nitrite and hydrogen peroxide solutions were determined. An increased $G(NO_2^-$ and $H_2O_2)$ was observed with increased dosage in dilute solutions. With M $NaNO_3$ $G(NO_2^-)$ is not a function of dose. (R.V.J.)

10163 CONCENTRATION AND RECOMBINATION OF RADICALS IN γ-IRRADIATION OF CONGEALED H_2O_2–H_2O SOLUTIONS. A. G. Kotov, S. Ya. Pshezhetskii, V. I. Milinchuk, V. I. Tsivenko (Karpov Inst. of Physics and Chemistry, Academy of Sciences, USSR). Kinetika i Kataliz, 4: 926-9(Nov.-Dec. 1963). (In Russian)

Effects of molecular and matrix properties on the concentration and recombination of radicals in irradiated hydrogen peroxide–water systems are investigated. Solutions were exposed at 77°K to 0.7 and 2.1 mr/hour of Co^{60} γ rays. A radiospectrograph with a double modulating field was used for recording EPR spectra of the produced radicals. Radical concentrations were determined by comparing EPR spectra of the solutions and standard paramagnetic monocrystals of $CuCl_2 \cdot 2H_2O$. The curves of the radicals as a concentration for specimens exposed to various radiation doses showed maximum concentrations at 50 to 60 wt % (30 to 35 mole %) H_2O_2. (R.V.J.)

10164 RADIATION-INITIATED POLYMERIZATION. PART I. SCREENING SPEEDS POLYMER STUDIES. P. J. Manno (Continental Oil Co., Houston, Tex.). Nucleonics, 22: No. 2, 49-51(Feb. 1964).

Parametric studies of optimum polymerization conditions are discussed. The advantage of radiation, the ability to screen a large number of monomers and polymerization conditions, permits rapid survey of monomers and monomer combinations to find a promising polymer. The polymerization parameters can then be screened. (R.E.U.)

10165 RADIATION-INDUCED SOLID STATE POLYMERIZATION. P. G. Garratt (Royal Military Coll. of Science, Shrivenham, Swindon, Eng.). Polymer, 3: 323-34 (Sept. 1962).

A review is presented on the radioinduced polymerization of acrylamide, carboxylic acid monomers, acrylonitrile and methacrylonitrile, non-vinyl monomers, ring compounds, and on photochemically initiated polymerization. It was concluded that the formation of amorphous polymer was probably universal in solid state polymerization, the crystal symmetry not imposing order and orientation on the polymer. Several arguments are put forward to extend the theory that the crystal lattice may impose control on the polymerization. 60 references are included. (P.C.H.)

10166 THE RADIATION CHEMISTRY OF SOME POLYAMIDES. AN ELECTRON SPIN RESONANCE STUDY. C. T. Graves and M. G. Ormerod (Royal Military Coll. of Science, Shrivenham, Swindon, Eng.). Polymer, 4: 81-91 (Mar. 1963).

Electron spin resonance spectroscopy was used to study the nature, concentration, and kinetics of disappearance of the free radicals produced in polyamides by gamma irradiation at 77°K. At this temperature, two radical species predominated, one of which was identified as $-CH_2-CO-NH-\dot{C}H-CH_2-$. At room temperature the radicals decay leaving a more stable species, which is probably a radical stabilized on a radioinduced double bond. G values for these radicals were calculated and the kinetics of their decay studied. Electron spin resonance data were related to the radiation chemical studies of others. Thus a scheme for the radioinduced reactions in polyamides is presented. (auth)

10167 THE EFFECT OF ZINC OXIDE ON THE COBALT-60 GAMMA INITIATED POLYMERIZATION OF VINYL MONOMERS AT LOW TEMPERATURES. F. L. Dalton and K. Hayakawa (Wantage Research Lab., Berks, Eng.). Polymer, 4: 285-6(June 1963).

An investigation was made on the effects of zinc oxide on the polymerization of styrene, α-methylstyrene, and cyclohexene, which are known to polymerize by a cationic mechanism, and methyl methacrylate and isoprene. The results showed that the additive produced very little change in polymerization rate of any of the monomers studied. (P.C.H.)

10168 RADIOLYSIS OF CARBON DISULPHIDE SOLUTIONS IN BENZENE AND CYCLOHEXANE. Stanislaw Ciborowski, Elzbieta Maciejewska, and Zbigniew Przybylowicz. Przemysl Chem., 42: 485-7(Sept. 1963). (In Polish)

Processes of decomposition, under the influence of gamma radiation, of carbon disulfide in diluted benzene and cyclohexane were studied. The products of reaction were non-volatile sulfur compounds that are easily separated by distillation from the hydrocarbons examined. The radiation yield of CS_2 decomposition is proportional to the concentration of CS_2 in solution. For solutions of 0.5 g/l CS_2 concentration the $G_{(-CS_2)}$ values in benzene and cyclohexane were respectively: 0.14 and 0.46 molecules, transformed as result of absorption in the system of 100 ev gamma radiation energy. The amounts of radiation energy, needed to decrease CS_2 concentration in solution in the assumed limits of the initial and terminal concentration, were given. The results obtained can be used in discussion concerning prospects of industrial application of radiation process. (auth)

10169 RADIOLYSIS OF NICKEL AMMONIUM COMPLEXES IN AQUEOUS SOLUTIONS. S. Ionescu and A. Kelusharu (Inst. of Nuclear Physics, Bucharest). Rev. Phys., Acad. Rep. Populaire Roumaine, 8: 285-90(1963). (In Russian)

Polarographic measurements were made of radiation effects on the formation and stability of nickel amines. The experiments were carried out with nickel hexamine and tetramine complexes irradiated by 10- and 6-mm cylindrical sources containing Au^{198}. (R.V.J.)

10170 THE EFFECTS OF GAMMA RADIATION ON COTTON. PART V. POST-IRRADIATION REACTIONS. Florine A. Blouin and Jett C. Arthur, Jr. (Southern Regional Research Lab., New Orleans). Textile Res. J., 33: 727-38(Sept. 1963).

Purified cotton cellulose dried to less than 0.5% moisture was irradiated in a nitrogen atmosphere with high-energy gamma radiation from cobalt-60 at selected dosages up to 6×10^6 roentgens. Post-irradiation chain cleavages of the cellulose molecule on exposure to air were indicated by decreases in the viscosity of the irradiated cellulose with increasing time after irradiation. Post-irradiation reactions of the irradiated cellulose with acrylonitrile were investigated. Low yields of graft polymer were obtained on treatment of the irradiated cottons with pure acrylonitrile, 5% acrylonitrile in water, and 32% acrylonitrile in N,N-dimethylformamide. The effect of temperature in the 23–100°C range on these treatments was investigated. High yields of graft polymer were obtained when the irradiated cottons were treated with acrylonitrile solutions in concentrated aqueous zinc chloride. The mechanical properties of selected fibrous graft polymers of cellulose–polyacrylonitrile were determined. Some irradiations were carried out in the presence of oxygen and moisture for comparison of the post-irradiation reactions. Results are discussed with relation to the production of long-lived free radicals in the cotton cellulose by high-energy gamma radiation. (auth)

10171 THE REACTION OF ORGANIC COMPOUNDS OF LOW MOLECULAR WEIGHT INITIATED BY COBALT-60 GAMMA-RADIATION. VIII. YIELDS OF FREE RADICALS FROM LOW MOLECULAR WEIGHT ORGANIC COMPOUNDS BY COBALT-60 GAMMA-RADIATION. Motome Hamashima. Tokyo Kogyo Shikensho Hokoku, 58: 550-2 (Dec. 1963). (In Japanese and English)

Styrene, vinylacetate, and methyl methacrylate were subjected to polymerization reactions initiated by irradiation with gamma rays from cobalt-60 sources in the presence of organic additives in a deaerated system. The yields of free radicals from the additives were calculated by means of the result of the radical yield from each monomer and results tabulated. The result of a yield of free radicals from an additive varies with the individual monomer. (P.C.H.)

10172 VARIATIONS IN EPR SPECTRA DURING OPTICAL BLEACHING OF IRRADIATED ORGANIC COMPOUNDS. V. G. Nikol'skii, M. V. Alfimov, and N. Ya.

Buben (Inst. of Chemical Physics, Academy of Sciences, USSR). Zh. Fiz. Khim., 37: 2797-8(Dec. 1963). (In Russian)

It is shown that paramagnetic centers that disappear under light form simultaneously with the radicals in the radiolysis of various organic compounds (polyethylene, polymethylmethacrylate, polystyrole, paraffin, etc). Such photosensitive centers show up in electron paramagnetic resonance as single (~20 e) width lines. Concentrations of radicals and photosensitive centers vary with dosage. At 1 to 3 Mr the concentration of photosensitive centers reaches a maximum; at doses exceeding 10 Mr they are absent. Thus, bleaching specimens exposed to high doses do not effect the EPR spectra. (R.V.J.)

10173 KOROTKOZHIVUSHCHII IZOTOP IODA-J^{132}. (Short-Life I^{132} Isotope). V. A. Sokolov. Moscow, Gosatomizdat, 1963. 24p.

Preparation and physical properties of I^{132} and Te^{132} are discussed, and methods for separating Te^{132} from neutron irradiated uranium and consequent separation of I^{132} from Te^{132} are analyzed. Applications of I^{132} in medicine, and safety measures for personnel handling I^{132} are also discussed. (R.V.J.)

10174 THE INFLUENCE OF TRAPS ON THE FLUORESCENCE MECHANISM. K. Lertes. Thesis, Berlin, Technical Hochschule, 1962. 81p. $2.00 (Gmelin, AEDDISS. 62-564).

The design of equipment for the measurement of short decay times with high resolution is described. To obtain a monotonous relation between luminescence after cathode ray excitation and temperature, a pressure of 10^{-6} mm Hg was used and additional cooling of the cathode ray tube was necessary. Thermoluminescence in tungstates and molybdates after excitation by x rays, cathode rays, and ultraviolet light is studied. It is concluded from an analysis of decay curves that the traps are produced in a luminescent center. A configuration model for a luminescent center with traps is outlined. Luminescence in zinc oxide is discussed. (Gmelin Inst.)

10175 CONTINUOUS SCINTILLATION COUNTING OF AMINO ACID ANALYZER COLUMN ELUATES. David H. Elwyn (Michael Reese Hospital and Medical Center, Chicago). 14p. (CONF-390-1)

From AIAA Heterogeneous Combustion Conference, Palm Beach, Fla., Dec. 1963.

The design, construction, calibration, and performance of scintillation counters with efficiencies in the range of 20 to 50% are discussed. The system described has been used for determining the specific activities of amino acids and related compounds in tissue extracts and in protein and lipid hydrolyzates after administration of labeled glycine and serine to dogs and rats. The counter is also suitable for work with tritium, S^{35}, P^{32}, I^{131}, and other isotopes. (P.C.H.)

10176 RADIOCHEMICAL YIELDS OF GRAFT POLYMERIZATION REACTIONS OF CELLULOSE. Jett C. Arthur, Jr., and Florine A. Blouin (Dept. of Agriculture, New Orleans). 23p. (CONF-37-5)

From American Chemical Society Southwest Regional Meeting, Dallas, Dec. 1962.

The preparation of radioinduced graft polymers of cotton cellulose, while retaining the fibrous nature and high molecular weight of the cellulose, depended primarily on the radiochemical yields of cellulose reactions and of graft polymerization reactions. Yields of the initial major molecular changes in cellulosic polymer indicated that, in the case of scission of the molecule and carboxyl group formation, chain reactions were not initiated by radiation; however, in the case of carbonyl group formation chain reactions were initiated but quickly terminated. Generally, experimental procedures, used in graft polymerization reactions, were: simultaneous irradiation reactions, that is, application of monomers or solutions of monomers to cellulose or chemically modified celluloses, then irradiation; and post-irradiation reactions, that is, irradiation of cellulose or chemically modified celluloses, then after removal from the field of radiation, contacting the irradiated cellulose with monomer. Some of the most important factors influencing the radiochemical yields of graft polymerization reactions of styrene and acrylonitrile onto cellulose were: concentration of monomer in treating solution; solvent; ratio of monomer solution to cellulose; prior chemical modification of cellulose; and absence of oxygen, particularly in post-irradiation reactions. Experimental data are presented, and the direct and indirect effects of Co^{60} gamma radiation on these reactions are discussed. (auth)

10177 PROCESS FOR THE PRODUCTION OF HYPOXANTHINE DERIVATIVES. Kazuo Uchida, Akira Kuninaka, Hiroshi Yoshino, and Masajiro Kibi (to Yamasa Shouy Kamushiki Kaisha and Yamasa Shoyu Co., Ltd.). U. S. Patent 3,118,820. Jan. 21, 1964. Priority date Nov. 24, 1959.

The process described is suitable for industrial production of hypoxanthine derivatives by employing auxotrophs that require only adenine for growth in the minimum medium. The auxotrophs are obtained by treatment of wild strains of microörganisms with ultraviolet light, x rays, gamma rays, or nitrogen mustard. The ultraviolet absorbing substances accumulated in the culture liquid are found to be inosine-5′-monophosphate, inosine, and hypoxanthine, and are separated by conventional means. (R.E.U.)

Separation Processes and Procedures

10178 (CEA-2349) LE PHOSPHATE DE TRI n-BUTYLE DANS L'EXTRACTION DU PLUTONIUM. RADIOLYSE ET RECYCLAGE DU SOLVANT. (The Use of Tri-n-Butyl Phosphate in Plutonium Extraction. Radiolysis and Recycling of the Solvent). Michel Isaac (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 54p.

The work concerns the radiolysis and recycling of tri-n-butyl phosphate used as extraction solvent for plutonium. The radiolysis is studied on an industrial solvent using a cobalt-60 source. Figures are given for the yield of the mono- and dibutylphosphoric acids formed from the dry and water-saturated solvents, and the influence of nitric acid on the formation of dibutylphosphoric acid is indicated. The recycling treatment of the solvent is reconsidered with a view to lowering the residual contamination due to fission products. The tests carried out on a solvent from the plutonium extraction plant at Marcoule show the efficiency of the sodium carbonate treatment. Of all the products studied, only caustic soda led to a better decontamination than sodium carbonate; in all cases, however, the elimination of ruthenium is always incomplete. (auth)

10179 (DP-847) HEAT AND MASS TRANSFER IN A TURBINE CONTACTOR. Donald S. Webster (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Dec. 1963. Contract AT(07-2)-1. 35p.

Tests are reported on a high-intensity mixer for solvent extraction. The two phases enter the mixer through axial ducts, are mixed by a paddle, and are discharged between peripheral vanes. The mixing volume enclosed by the vanes is used with heat transfer measurements to evaluate an observed heat transfer coefficient per unit volume, Us. For comparison, the over-all heat transfer coefficient at the surface of a rigid spherical drop of dispersed phase is combined with mean drop surface area and number of drops per unit volume to yield theoretical values of Us; agreement with observed values is good. However, analogous treatment of mass transfer measurements results in calculated mass transfer coefficients per unit volume of mixture that are lower than "observed" coefficients by a factor of fifty. To obtain agreement it is necessary to postulate that circulation occurs within the drop as a function of turbulent velocity and interfacial tension; this postulate then allows transfer coefficients of the proper magnitude to be calculated by penetration theory. (auth)

10180 (HW-SA-3282) NEW NEPTUNIUM PURIFICATION FACILITY AT THE HANFORD PUREX PLANT. J. P. Duckworth and J. R. LaRiviere (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 26, 1963. Contract AT(45-1)-1352. 19p.

The Np^{237} which has been recovered from irradiated fuels in the Purex and Redox Plants, contains contaminants that must be removed before it can be converted to Pu^{238} by irradiation. A description is given of the batch ion-exchange facilities installed in the Purex Plant for Np purification. (D.L.C.)

10181 (IDO-14619) AN IMPROVED AQUEOUS PROCESS FOR ZIRCONIUM ALLOY NUCLEAR REACTOR FUELS. PART II. CONTINUOUS DISSOLUTION WITH 5M HYDROFLUORIC ACID. B. J. Newby (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Sept. 25, 1963. Contract AT(10-1)-205. 19p.

Increased use of uranium–zirconium alloy fuels in propulsion reactors indicates that a high-capacity process for the recovery of enriched uranium from such fuels will be needed in the near future. Modification of the existing batch hydrofluoric acid process, to provide continuous dissolution, appears to be the most practicable way to install a high capacity process for uranium–zirconium alloy fuels in the Idaho Chemical Processing Plant. Dissolution in about 5M hydrofluoric acid is preferred because it results in the dissolution of fuels containing higher percentages of uranium and solutions more stable with respect to zirconium and fluoride salts than do higher concentrations of hydrofluoric acid. All of the zirconium and uranium and one-third of the tin in a 2.5% uranium–Zircaloy-2 fuel can be dissolved continuously and retained in solution with 5M hydrofluoric acid at a dissolution temperature of 60 to 80°C and a dissolver feed rate to fuel-surface ratio of 0.04 cm/min. The hydrofluoric acid also readily attacks oxidized zirconium alloy. Oxidants are not necessary in the dissolution. The dissolver product contains only a trace of zirconium fluoride salts, even after standing for several months. (auth)

10182 (JINR-P-1455) VYDELENIE NEITRONODEFITSITNYKH IZOTOPOV ELEMENTOV TSERIEVOI GRUPPY REDKIKH ZEMEL' IZ ERBIYA, OBLUCHENNOGO PROTONAMI 680 Mev. (Extraction of Neutron-Deficient Isotopes of Rare-Earth Elements of the Cerium Subgroup From Erbium Exposed to 680 Mev Protons). E. Herrmann (Kherrmann), H. Grosse-Ruiken (Kh. Grosse-Ryuken), N. A. Lebedev, and V. A. Khalkin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1963. 13p.

Light lanthanides which are formed from erbium when it is irradiated to 680 Mev protons are separated simply and rapidly from two grams of the target material by the method of the distribution chromatography on the silica gel which was impregnated with di(2-ethylhexyl)orthophosphoric acid. It is not difficult to construct the apparatus for the remote control of this separation. This is very important in handling the materials with the radioactivity of several gram-equivalents of radium. Combined with the ion-exchange chromatography, this method was used to obtain the neutron-deficient isotopes of some elements of the cerium subgroup of the rare earths which were needed for nuclear spectroscopy. (auth)

10183 (TID-7675(p.46-56)) REMOVAL OF PROTACTINIUM AND URANIUM FROM THORIUM NITRATE–NITRIC ACID SOLUTIONS. G. L. Johnson, D. R. Cuneo, H. F. McDuffie, and M. J. Kelly (Oak Ridge National Lab., Tenn.).

The main problem in the use of $Th(NO_3)_4$ solutions as breeder blankets in homogeneous reactors is the separation of Pa^{233} and U^{233} from the solutions. Laboratory-scale tests were made on the method of peroxide precipitation as a method of removing Pa tracer from HNO_3–$Th(NO_3)_4$ solutions. Pa was found to be removed quantitatively with the precipitate, although in one experiment using U along with Pa, U was not removed. (D.L.C.)

10184 (UJV-911/63) THE USE OF AMMONIUM SALTS OF HETEROPOLY ACIDS FOR THE ^{137}Cs ISOLATION. J. Krtil, V. Kouřím, and Z. Kelařík (Československá Akademie ved. Ustav Jaderneho Vyzkumu, Řež). [1962?]. 14p.

A method of Cs^{137} selective desorption on ammonium salts of heteropolyacids (HPA) from mixtures of fission products was studied. Experiments were carried out on a column of the ammonium salt of phosphotungstic and phosphomolybdic acids. The efficiency of cesium elution by 10 M ammonium nitrate solution was investigated. Excess ammonium nitrate was decomposed by heat treatment or by means of a mixture of nitric and hydrochloric acids. Decomposition of the ammonium salts of HPA by ammonium hydroxide was proposed as an alternative method for the separation of cesium. Components of decomposed HPA were precipitated as barium salts. (auth)

10185 THIN-LAYER IONOPHORESIS OF INORGANIC COMPOUNDS AT LOW AND HIGH VOLTAGE USING RADIONUCLIDES. A. Moghissi (Kernforschungszentrum, Karlsruhe, Ger.). Anal. Chim. Acta, 30: 91-5(Jan. 1964). (In German)

Thin-layer ionophoresis was used for separating inorganic substances. Separations were carried out at 13 or 45 v/cm using radionuclides. The equipment used is described. High voltage ionophoresis was conducted either under cooling or in an atmosphere of water vapor. Migration times under these conditions were 2 or 5 min, respectively. (auth)

10186 EXTRACTION OF RUTHENIUM-106 BY POLYVINYL CHLORIDE DISSOLVED IN NITROBENZENE. SEPARATION OF RUTHENIUM-106 FROM FISSION PRODUCTS AND SEA WATER. Tsu-Chang Hung (Inst. of Chemistry, Academia Sinica, Taipei, Japan), Motoharu Tanaka, and Yoshio Koda. Bull. Inst. Chem. Acad. Sinica, No. 8, 49-55(Oct. 1963).

The use of polyethylene chloride as an extractant was found to be more rapid and has a better efficiency than other methods for the separation and determination of

Ru^{106} from a mixture of fission products. Experiments were performed to determine Ru^{106} from fission products. The final precipitates were extracted with 0.1% PVC dissolved in nitrobenzene. The determination of Ru^{106} in natural water is possible by coprecipitation followed by extraction. (P.C.H.)

10187 THE FIVE-COMPONENT SYSTEM $UO_2(NO_3)_2$–$(C_4H_9)_2PO(C_4H_9O)$–H_2O–HNO_3–CCl_4 AT A CONSTANT RATIO OF $(C_4H_9)_2PO(C_4H_9O)$ TO CCl_4 IN A REGION OF PHASE SEPARATION. A. V. Nikolaev, Yu. A. Dyadin, I. I. Yakovlev, and Z. N. Mironova (Inst. of Inorganic Chemistry, Siberian Section of the Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 153: 118-21(Nov. 1, 1963). (In Russian)

A constant concentration (27.6 wt %) of the monobutyl ether of dibutylphosphinic acid (BEDBP) in a CCl_4 solution was taken as one component. Hence, the system was a pseudo four-component system. The formation of three liquid phases was not observed at any time. Samples of the aqueous and organic phases were taken for analysis. Nitric acid was determined by potentiometric titration, uranium by arsenazo-1 or by xylidine orange, and water by Fisher's method. The phase diagram shows a two-phase region, a homogeneous organic phase with 2% water and up to 20.2% uranyl nitrate, and various hydrates of $UO_2(NO_3)_2$ in contact with an organic phase. The distribution coefficients of $UO_2(NO_3)_2$ are plotted as isolines. The diagram indicates the formation of a solvate $UO_2(NO_3)_2 \cdot 2BEDBP$. This solvate was isolated in the form of yellow crystals melting at 53.8 ± 0.3°C and decomposing at 234°C. The isolines of the uranium distribution coefficients indicate that nitric acid has only a slight salting-out effect on the recovery of uranium in this solvent system. (TTT)

10188 PREPARATION OF PURE OXIDES OF NIOBIUM AND TANTALUM FROM INDIAN COLUMBITE AND TANTALITE. B. Sarma and J. Gupta (National Chemical Lab., Poona, India). Indian J. Tech., 1: 311-16(Aug. 1963).

A promising solvent extraction procedure, employing cyclohexanone or methyl n-propyl ketone, was developed for the preparation of niobium and tantalum oxides of more than 99.9% purity from Indian columbite. The procedure involves the opening of the mineral by alkali fusion followed by washing and leaching with hydrochloric acid to obtain a mixture of hydrous oxides of niobium and tantalum. The air-dried oxides are dissolved in 40% hydrofluoric acid in the cold and necessary amount of hydrochloric acid added to adjust the acidity of the solution, which is then subjected to solvent extraction, when tantalum goes into the organic phase and niobium remains in the aqueous phase. The oxides are precipitated with ammonia and ignited. Good separations with respect to yield and purity of oxides are achieved by maintaining the acidity of the solutions at 0.5N and the solute concentration (wt/vol) at ca 10% in the case of cyclohexanone and 20% in the case of methyl n-propyl ketone. (auth)

10189 QUANTITATIVE SEPARATION OF NIOBIUM FROM TITANIUM, IRON, ETC., FROM FLUORIDE SOLUTIONS. B. Sarma (National Chemical Lab., Poona, India). Indian J. Tech., 1: 331-2(Aug. 1963).

Niobium precipitates quantitatively as a flocculent mass when its fluoride solution is boiled with boric acid. If pyrogallol is added before the addition of boric acid, impurities other than tantalum form soluble pyrogallol complexes and remain in solution. (auth)

10190 INERT DILUENTS FOR USE IN NUCLEAR ENERGY PLANTS. III. COMPARISON OF THE STABILITY OF SOME CONJUNCT POLYMERS OF SIMPLE OLEFINS WITH ODOURLESS KEROSENE. E. S. Lane and M. J. Holdoway (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). J. Appl. Chem. (London), 13: 310-16 (July 1963).

The preparation of some steam-volatile fractions of conjunct polymers of some readily available olefins is described. Assessment as inert diluents indicated that these fractions were more stable toward nitric acid than odorless kerosene but less stable than n-dodecane. The main constituents in the steam-volatile fraction of the conjunct polymer from dodec-1-ene were identified as isomeric monomethylundecanes by means of the methylene insertion reaction. The occurrence of a series of isomeric monomethylalkanes in a kerosene fraction and in a fully hydrogenated fraction from a Fischer-Tropsch hydrocarbon synthesis (Mepasin) was also demonstrated. (auth)

10191 MOLYBDENUM SPECIES IN ACID SOLUTION. I. L. Jenkins and A. G. Wain (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Appl. Chem. (London), 13: 561-4(Dec. 1963).

Solutions of sodium and ammonium molybdate in nitric and in perchloric acids were examined. The existence of polymeric molybdenum species at acidities greater than 0.1M HNO_3 was established by diffusion experiments. Measurements of the absorption spectra and of the distribution of molybdenum between monododecyl phosphoric acid and aqueous nitric acid indicate the existence of a monomeric species at molybdenum concentrations below 0.001M and of polymerisation at higher concentrations. The monomer is probably a hydrated ion of the type $(MoO_2, xH_2O)^{2+}$, and the polymer is probably a dimer. (auth)

10192 SOME LIQUID PHASE DIFFUSION COEFFICIENTS OF URANIUM AND PLUTONIUM. W. Knoch (Technical Universität, Braunschweig, Ger.). J. Chem. Eng. Data, 9: 60-1(Jan. 1964).

Diffusion coefficients of Pu(IV) and U(VI) in nitric acid solutions and some actual solvent extraction systems like tributylphosphate-kerosene and tri-iso-octylamine-xylene were determined. Activation energies for the U-diffusion were also calculated. (auth)

10193 SYNERGISTIC EFFECT IN THE SOLVENT EXTRACTION OF THORIUM. Si-Jung Yeh and Po-Chen Chu (National Tsing Hua Univ., China). J. Chinese Chem. Soc. (Taiwan) (2), 10: 1-15(Mar. 31, 1963).

By using Th^{234} as tracer, the synergistic effects in the extraction of thorium from aqueous solutions with mixtures of organic solvents were investigated for the system Th^{4+}/β-diketones/TBP/diluents. Four β-diketones (acetylacetone, benzoylacetone, dibenzoylmethane, and trifluoroacetone) were used. Synergistic enhancements on the distribution ratios were observed in all cases except when acetylacetone was used as the chelating agent at the pH range of 2-3. Based on the experimental observations, a plausible mechanism for the synergistic effect is suggested. The effect of diluent is also discussed. (auth)

10194 ON THE STUDY OF TETRAHYDRATED DOUBLE SULPHATE OF TERVALENT ELEMENTS WITH RADIOACTIVE INDICATORS. PART I. B. C. Purkayastha and D. K. Bhattacharyya (Saha Inst. of Nuclear Physics, Calcutta). J. Indian Chem. Soc., 40: 871-8(Oct. 1963).

Distribution studies with $(NH_4)Ce(SO_4)_2 \cdot 4H_2O$ as host and Y^{91} and $Eu^{152,154}$ as guests showed that distribution factors have constant values both at tracer scale and in finite concentrations of the guest ions, thus providing a convincing evidence that tetrahydrated double sulfates of yttrium and europium like that of cerium do also exist. That diffusion in the crystal of the host lattice is a very slow process

was demonstrated by a study of the rate of uptake of Ce^{144} (ous) by preformed $(NH_4)Ce(SO_4)_2 \cdot 4H_2O$ crystals in contact with its saturated solution in $3\underline{N}$-H_2SO_4. (P.C.H.)

10195 THE EXTRACTION OF URANIUM(VI) FROM SULPHURIC ACID SOLUTIONS BY CYCLOHEXYL-ALKYLAMINES. Taichi Sato (Government Chemical Industrial Research Inst., Tokyo). J. Inorg. Nucl. Chem., 26: 171-9(Jan. 1964).

The effects of amine structure and of organic solvent on the extraction of uranium(VI) from sulfuric acid solutions by cyclohexyl-alkylamines were investigated. It was found that the uranium extraction efficiency of cyclohexyl-alkyl secondary amines is greater than that of cyclohexyl-alkyl tertiary amines; when the alkyl chain is branched the extraction efficiency of the amine is reduced and much influenced by the properties of the organic solvent used as diluent. The mechanism of uranium extraction by cyclohexyl-dodecylamine was also studied. (auth)

10196 THE EXTRACTION OF URANIUM(VI) FROM SULPHURIC ACID SOLUTIONS BY BENZYL-ALKYLAMINES. Taichi Sato (Government Chemical Industrial Research Inst., Tokyo). J. Inorg. Nucl. Chem., 26: 181-9 (Jan. 1964).

The effects of amine structure and organic solvent on the extraction of uranium(VI) from sulfuric acid solutions by benzyl-alkylamines were investigated. Also, the mechanism of uranium extraction by benzyldodecylamine was studied. (auth)

10197 COMPLEX FORMATION IN THE DILUTE URANYL NITRATE–NITRIC ACID–DIBUTYL PHOSPHORIC ACID–TRIBUTYL PHOSPHATE–AMSCO SYSTEM. H. T. Hahn and E. M. Vander Wall (Philips Petroleum Co., Idaho Falls, Idaho). J. Inorg. Nucl. Chem., 26: 191-202(Jan. 1964).

The re-extraction of uranium(VI) from TBP-Amsco solution into dilute nitric acid is hindered by the presence of dibutyl phosphoric acid. Attempts to correlate observed extraction coefficients with published equilibrium data established that the extraction coefficient of uranium is actually greater than calculated from the published data. The empirical formula of the previously undescribed complex is $[UO_2(NO_3)(DBP) \cdot TBP]_x$. Good agreement with the experimental data is obtained with $x = 2$. For this complex $\log K = 12.5$. A characteristic set of six ultra-violet absorption peaks is associated with the complex. (auth)

10198 A SURVEY OF HEADEND PROCESSES FOR NUCLEAR FUEL REPROCESSING. Cyril M. Slansky (Phillips Petroleum Co., Idaho Falls, Idaho). J. Metals, 16: 25-32(Jan. 1964).

The latest developments in the chemical reprocessing of spent nuclear fuels are reviewed with particular accent on operating plants. Trends in the development of multipurpose headends for a range of enrichments, geometries, and alloy components are given. The general design features of small- and large-scale plants are compared, and their significance to commercial application is reviewed. Progress in nonaqueous and pyrometallurgical reprocessing methods is reported. Research and development are reported for headend processes for new fuel compositions and fuel claddings. (auth)

10199 GAS CHROMATOGRAPHY AS APPLIED TO NUCLEAR TECHNOLOGY. II. ANALYSIS OF THE HYDROLYSIS PRODUCTS OF URANIUM CARBIDES AND THORIUM CARBIDES. A. D. Horton and J. L. Botts (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 18: 97-104(Jan. 1964).

Gas chromatography was used for qualitative and quantitative determination of the products of the hydrolysis of uranium carbides and of thorium carbides. The products were separated on four columns: 5A molecular sieve, di-2-ethylhexyl sebacate, tricresyl phosphate, and silica gel modified with squalane. The hydrocarbons were identified by use of known gaseous and liquid alkanes, alkenes, and alkynes. The numerical data were obtained by IBM 7090 computation. (auth)

10200 ON THE SEPARATION OF PRASEODYMIUM AND NEODYMIUM BY THE USE OF THE SEPARATING ELEMENTS. Boguslaw Borkowski and Barbara Zielinska. Przemysl Chem., 42: 487-90(Sept. 1963). (In Polish)

Experiments were carried out on the ion exchange separation of Pr and Nd by using Al^{3+}, Zn^{2+}, Cd^{2+}, and Co^{2+} as separating elements. The results obtained with the aid of these elements were compared with those obtained by others with Mn^{2+}, as well as with Cu^{2+}, used frequently as a barrier in separating rare earth elements. The experiments proved that aluminum is a very good agent in separation of praseodymium and neodymium, its action being similar to that of manganese. (auth)

10201 ELECTROLYTIC ISOLATION OF POWDERED ZIRCONIUM FROM FUSED SALTS. I. N. Sheiko (Inst. of General and Inorganic Chemistry, Odessa). Ukr. Khim. Zh., 29: 57-63(1963). (In Russian)

Electrolysis of molten zirconium dioxide, zirconium tetrachloride potassium and sodium fluozirconate, and mixtures of potassium fluozirconate and zirconium dioxide showed best results with $KCl-NaCl-NaF-ZrO_2$ at 2.5 to 3.5 amp/cm^2, 700°C, and 3.0 to 3.3 v. The precipitant contained 96.8% metal. It was found that the separation of zirconium from systems containing ZrO_2 results from zirconium reduction by alkali or alkaline earth metals. (R.V.J.)

10202 STUDY OF THE CERIUM–MOLYBDENUM COMPLEX. Yu. F. Shkaravskii (Inst. of General and Inorganic Chemistry, Odessa). Ukr. Khim. Zh., 29: 356-9 (1963). (In Russian)

It is shown that cerium–molybdenum complex extraction by ketones and ethyl acetoacetate is very weak. The complex does not lend itself to extraction by alcohols, simple or complex ethers, or neutral solutions. Conductometric titration showed that the cerium-molybdenum complex is a strong octabasic acid, as described by the Milati-Rozenheim-Pfeiffer formula $H_8[RO_6MO_{12}O_{36}]$*, (where R is a tetravalent cation). (R.V.J.)

10203 INVESTIGATION OF THE ISOTHERMS OF ION-EXCHANGE SORPTION OF ZIRCONIUM AND HAFNIUM BY KU-2 CATIONITE. I. V. Vinarov and A. N. Greenberg (Inst. of General and Inorganic Chemistry, Odessa). Ukr. Khim. Zh., 29: 1013-15(1963). (In Russian)

Ion exchange equilibrium in zirconium and hafnium sorption from their oxychlorides in nitric acid by cation resin (KU-2) at 25°C was studied. The ion exchange isotherms of Hf and Zr are almost identical, thus preventing separation. (R.V.J.)

10204 REGENERATION OF FISSION-PRODUCT-CONTAINING MAGNESIUM–THORIUM ALLOYS. P. Chiotti (to U. S. Atomic Energy Commission). U. S. Patent 3,120,435. Feb. 4, 1964.

A process of regenerating a magnesium–thorium alloy contaminated with fission products, protactinium, and uranium is presented. A molten mixture of $KCl-LiCl-MgCl_2$ is added to the molten alloy whereby the alkali, alkaline earth, and rare earth fission products (including yttrium) and some of the thorium and uranium are chlorinated and

taken up by the salt, while the protactinium, some of the calcium, cerium, and lanthanum remain in the alloy. The isolated salt phase is then scrubbed with a molten zinc–magnesium reducing alloy (2 to 4% Mg) whereby metals are formed from the chlorides of cerium, yttrium, trivalent rare earths, uranium, and thorium, and alloyed with the zinc-magnesium, while the alkali, alkaline earth and samarium chlorides remain in the salt. (AEC)

ENGINEERING

General

Refer also to abstract 10320.

10205 (ACNP-63035) STEAM SEPARATION TECHNOLOGY UNDER THE EURATOM PROGRAM. Quarterly Progress Report, October 1, 1963–December 31, 1963. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Jan. 10, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1186. 99p. (EURAEC-927)

Carryover experiments in the steam-water test facility are complete. The experiments determine the maximum permissible steam release rate from a two-phase interface. Steam volume fraction measurements, run in conjunction with the carryover tests, are correlated, and the correlation equation is in final form. The centrifugal type downcomer separator, is now being tested in the steam-water facility. Pressure drop and flow-characteristic results from the test are in line with those predicted from the air-water facility. A 6-inch diameter centrifugal type upflow separator is developed and tested in the air-water facility. Results show that this separator has a relatively high pressure drop; however, carryunder characteristics are good. An 8-inch diameter centrifugal type upflow separator, which has lower pressure drop than the 6-inch separator, is being tested. The inverted cone type separator, which is made of perforated plate suspended over the downcomer, is tested. Results show this type of separator does not decrease carryunder appreciably. Test of a radial arc separator is in progress. (auth)

10206 (RMO-3005) MONTICELLO MILL TAILING EROSION CONTROL PROJECT, MONTICELLO, UTAH. (Grand Junction Office, AEC). Dec. 20, 1963. 34p.

The uranium processing mill was operated for vanadium production from 1942 to 1944, taken over by AEC in 1948, and operated from 1949 until shutdown in Jan. 1960. After shutdown, the tailing ponds gradually dried out and were subject to wind and water erosion. To eliminate possible public nuisance, the tailings were stabilized, leveled, graded, and covered with soil, and grasses were sown on the cover. (D.L.C.)

10207 (WT-86) BLAST LOADING AND RESPONSE OF PROTOTYPE STRUCTURES AND QUARTER SCALE MODEL. VOLUME III OF APPENDIX E, BLAST LOADING AND STRUCTURAL RESPONSE. (Illinois Inst. of Tech., Chicago. Armour Research Foundation). 1951. For Fisher (Howard T.) and Associates, Inc., Chicago. Project 3.3 of OPERATION GREENHOUSE. 419p. Contract AF33(038)-9761.

A study was made in order to predict the blast loading and response of the industrial-type, scale-model industrial type, and brick-dwelling type Air Force structures. The most important difference between these analyses and previous work is the consideration of the behavior of components, in particular, windows, and masonry panels. The interrelation of panel loading, panel response, and loading of the main frame results in an iterative procedure between the loading and response phases. The assumed behavior of masonry panels divides the motion of the panel into three phases: elastic panel, flat arch, and rigid body. This report contains the loading and response of the structures with the exception of the dwelling type building. The nature of these structures were such that little or no analysis could be performed. It is concluded that further shock tube and model studies should be performed. (auth)

10208 ELECTRIC PROPULSION. Ernst Stuhlinger (George C. Marshall Space Flight Center, Huntsville, Ala.). Elec. Eng., 82: 459-65(July 1963).

The types of electric propulsion systems are reviewed and some space applications are discussed. The evolution of research in electric propulsion from physicist to engineer is discussed. (R.E.U.)

10209 END-EFFECT CORRECTION FOR STRIP BEAM ION ENGINES. N. B. Kramer and E. G. Todd (Hughes Research Labs., Malibu, Calif.). J. Appl. Phys., 34: 3140-1(Oct. 1963).

Trajectory control at the end of a linear strip type gun geometry for cesium contact ion engines is discussed. End electrode designs for maintenance of the proper electric field configuration at the beam end are presented. (C.E.S.)

10210 NUCLEAR ENGINEERING FUNDAMENTALS. Roy Weinstein, Alvin Boltax, and Giovanni Lanza. New York, McGraw-Hill Book Company, 1964. 983p. $20.00.

Five books entitled Atomic Physics, Nuclear Physics, Interaction of Radiation and Matter, Nuclear Materials, and Nuclear Reactor Theory are included. Separate abstracts were prepared for each of the five books. (C.E.S.)

For abstracts of individual sections see: 10798, 10978, 11293, 11375, and 11390.

Applications of Nuclear Explosions

10211 (AD-402358) ANALYSIS AND EVALUATION OF SEISMIC DATA FOR ON-SITE INSPECTION, PROJECT VELA. Final Report. Lawrence B. Luhrs and Lawrence L. Davis (Beers (Roland F.), Inc., Alexandria, Va.). Feb. 23, 1963. Contract AT33(600)-43368. 255p.

Seismic and geological data obtained around test sites before and after underground explosions were reviewed, and their significance for purposes of on-site inspection was evaluated. Corresponding data on the physical properties of the test areas were treated similarly. (D.C.W.)

10212 (AFSWC-TDR-63-53) CLOSE-IN EFFECTS FROM NUCLEAR EXPLOSIONS. Final Report. D. C. Anderson, R. D. Fisher, E. L. McDowell, and A. H. Weidermann (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 1963. Contract AF29(601)-5008. 138p. (AD-411132)

The close-in effects from subsurface and surface nuclear explosions are treated analytically. Nuclear and chemical explosive efficiencies are computed for several real materials. By comparison of these efficiencies a nuclear-HE equivalence is established from which various close-in effects such as cratering may be scaled. The equivalences are found to be dependent on such material properties as water content, vaporization level, and Hugoniot relations. In addition, a one-dimensional model for describing stress propagation in real materials is presented. A material description which is independent of any specific stress field is developed. It is shown that dissipation effects in plane waves which have been attributed to strain rate effects can be equally well accounted for by deviatoric effects. An ana-

lytical method is presented for predicting surface spalls resulting from deep subsurface explosions. The results of the method are shown to be dependent on both tensile and shear strengths. (auth)

10213 (UCRL-7515) FEASIBILITY OF USING NUCLEAR EXPLOSIVES TO EXTRACT WATER FROM LUNAR ROCKS. R. A. Heckman (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 25, 1963. Contract W-7405-eng-48. 15p. (CONF-386-1)

From Mining and Processing Subgroup of the Working Group for Extraterrestrial Resources, Golden, Colo., Sept. 1963.

The feasibility of a proposal to use nuclear explosives for in situ dehydration of lunar water-bearing deposits is investigated. Nuclear explosives are an obvious economic choice over conventional explosives for such use because of their much greater yield-to-weight ratio. For deep water-bearing deposits, contained explosions would be used. A relationship is worked out giving minimum depths for containment of explosions in the lunar environment. These range from 2,000 to 10,000 feet for the explosive yields of 1 to 100 kilotons that are contemplated. It appears feasible to emplace and detonate nuclear explosives at these great depths on the moon, but a complete evaluation of the technique must await knowledge of the geological nature of water-bearing deposits at these depths. For shallow lunar water-bearing deposits, use of "earth-moving" nuclear explosions coupled with mining techniques appears attractive. (auth)

10214 RESULTS OF "GNOME" PEACEFUL NUCLEAR DETONATION IN NEW MEXICO. Engineer, 215: 602-4 (Mar. 29, 1963).

The characteristics and physical effects of underground nuclear detonations in a salt medium, the feasibility of converting the energy from the explosion into heat for the production of electrical power, and the practicability of recovering useful radioisotopes are discussed. The radiation generated and neutron cross section experiments are described. (C.E.S.)

10215 PLOWSHARE PROGRAM AND FUNDAMENTAL SCIENCE. p.167-80 of "Fundamental Nuclear Energy Research." Washington, D. C., GPO, 1963.

The neutron physics and seismological research conducted during Project Gnome are summarized, together with some plans for Project Coach. Transplutonium elements were produced in a test in the Coach device development. (D.C.W.)

Facilities and Equipment

Refer also to abstract 10474.

10216 (HW-79205) DOME SEAL PERFORMANCE TESTS. D. H. White (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1963. Contract AT(45-1)-1350. 42p.

A high temperature, high pressure, self-tightening, metal-to-metal nozzle closure known as a Dome Seal was tested and found to be unusually leak tight in a high-temperature water environment. The dome seal appears to have considerable promise for nuclear reactor application, as well as many other applications where zero leakage at high pressure and/or high temperature is required. (auth)

10217 (LNF-63/54(p.24-6)) PROGETTO DI UNA STAZIONE SPERIMENTALE SOTTO IL MONTE BIANCO. (Design for an Experimental Station under Mont Blanc). C. Castagnoli, A. De Marco, and A. Masani.

The tunnel through Mont Blanc offers favorable opportunities for research on cosmic radiation and in other fields such as radioactivity and geophysics. A brief indication is given of the precise studies possible. The characteristics of the laboratory to be constructed off the tunnel are given. (J.S.R.)

10218 (NAA-SR-8515) PHOTOELASTIC DETERMINATION OF STRESSES IN THE AI STEAM GENERATOR. M. M. Levin and M. M. Lemcoe (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 30, 1964. Contract AT-11-1-GEN-8. 53p.

The tangential ligament stresses σ_1 on the surface of the penetrations have two peak tensile values: one near the trepanned top surface and the other near the bottom spherical surface. In between these two planes, the principal stress σ_1 is a somewhat smaller, almost constant, tension indicating almost complete membrane stress. The maximum upper peak was found to be 3.9 p, while the maximum lower peak was 4.8 p, which was the maximum stress found anywhere in the steam generator. The maximum stress of 4.8 p occurs on the penetrations which have been rounded at the spherical surface. For the sharp cornered penetrations, a maximum peak stress of only 4.1 p was obtained. No satisfactory explanation can be offered for this. However, it is safe to state that no stress improvement results from rounding of the penetration corners. On the outer surface of the steam generator, a maximum tensile stress of 3.5 p was found at the fillets between standpipes 1 and 2. Principal stress distributions along a number of other key sections and points are presented in tabular and graphical form. (auth)

10219 (NP-13571(p.21-3)) HIGH-VOLTAGE SILVER-MYLAR CAPACITORS. H. R. D. Roess (Naval Research Lab., Washington, D. C.).

Mylar sheets coated with silver were found to have capacity of about 87 pf/in.^{2} at 1 kc, a breakdown voltage of about 22 kv, and virtual freedom from pin holes or thin spots. At 20 kv in air only a few creepage flashovers occurred, usually at about one-half of breakdown voltage and with no mylar damage. A pulse-forming line capacitor with negligible internal inductance was formed from such sheets, as was a cylindrical capacitor for use with a dual output hard-tube modulator. (D.C.W.)

10220 REMOTE CONTROL, PRECISION PIPETTE FOR THE REMOVAL OF RADIOACTIVE AND INFECTIOUS SOLUTIONS AS WELL AS SUPERNATANT LIQUIDS. Sandor Gyoryi and Jozsef Gazso (Medical Univ., Budapest). Kiserl. Orvostud., 15: 669-70(Dec. 1963).

A new pipette design that incorporates the advantages of other models is described. It is mounted, its height can be adjusted with precision, and it can be moved by a screw from tube to tube. The suction is achieved by a rubber bulb that enables the safe and exact separation of phases with small amounts of liquid. It is operated by one person and is easily decontaminated. (OTS)

10221 INTERCHANGEABLE HEARTH ARC FURNACE. O. L. Kruger and J. L. Armstrong (Argonne National Lab., Ill.). Rev. Sci. Instr., 35: 156-8(Feb. 1964).

A laboratory arc furnace that can be used for making buttons and castings of special shapes is described. The furnace was constructed so that copper hearths of various configurations could be rapidly interchanged. Convenience of operation inside a glove box was one of the principal considerations in its design. (auth)

10222 LINEAR MOTION DEVICE. E. Frisch and T. F. Widmer (to U. S. Atomic Energy Commission). U. S. Patent 3,122,027. Feb. 25, 1964.

A step-by-step linear motion magnetic device actuated by a plurality of solenoids is described. The device is constructed of a linearally movable element, a pair of spaced gripper means, a load transfer magnet that shifts the movable load from one gripper to the other, and means for the appropriate gripper to engage or disengage the movable element without forces being applied thereto, thus rendering the sliding wear negligible. Magnetic means to cause incremental movement of the appropriate gripper engaged with the movable element are provided. (AEC)

Heat Transfer and Fluid Flow

Refer also to abstract 11416.

10223 (AEEW-R-279) A THEORY OF BURN-OUT IN HEATED CHANNELS AT LOW MASS VELOCITIES. J. Randles (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). 1963. 22p.

At low coolant mass velocities, the fraction by weight of vapor flowing out of heated channels can become extremely large (~90%). Consequently, the dominating feature of burnout at small flow rates is that it occurs at high vapor qualities. For such a high degree of evaporation, the induced turbulence is very strong and the liquid phase is dispersed into a spray of droplets. By the application of the first law of thermodynamics and some basic relationships of turbulence theory to this spray, it is shown how an expression for the critical heat flux can be derived. By comparing this expression with the data from burnout measurements on uniformly heated channels, reasonably good agreement is obtained. It is demonstrated that eddy slip and channel geometry are extremely important in the determination of the level of turbulence in the droplet motion. Having thus established a reasonable degree of plausibility for the theory, it is applied to channels heated by a chopped cosine form of power distribution. The results indicate that the effect of the axial variation of the power on the burnout heat flux can be described in a simple manner. (auth)

10224 (EURAEC-855) SOME BURN-OUT AND INSTABILITY EXPERIMENTS ON A 7-ROD CLUSTER. C. L. Spigt and M. Bogaardt (Eindhoven, Netherlands. Technische Hogeschool). July 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 032-60-11-RDH. 27p. (CONF-309-3)

From EAES Symposium on Two-Phase Flow Steady-State Burnout and Hydrodynamic Instability, Studsvik, Sweden, Oct. 1963.

Burn-out and hydraulic stability experiments under natural convection were carried out at saturation temperatures of 230, 200, 180, and 140°C with a 7-rod bundle test section where geometry was very close to a Halden Boiling Water Reactor second charge fuel element. The inlet sub-cooling was varied. Local high heat fluxes to probe burn-out were obtained by the hot patch technique. The majority of the burn-out trips occurred with the top half of the middle rod of the bundle overheating under conditions of noisy periodic flow oscillations. The effect of an exit constriction in the test section was to make the system less stable hydraulically. (auth)

10225 (EURAEC-857) THE ONSET OF HYDRAULIC INSTABILITIES IN AN ANNULAR CHANNEL. C. L. Spigt, F. J. M. Dijkman, and M. Bogaardt (Eindhoven, Netherlands. Technische Hogeschool). Sept. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 032-60-11-RDH. 41p. (CONF-209-2)

From EAES Symposium on Two-Phase Flow Steady State Burnout and Hydrodynamic Instability, Studsvik, Sweden, Oct. 1963.

The results of an experimental study of the onset of instabilities in a vertical boiling channel are presented. An attempt is made to define a suitable criterion for the onset of instabilities using auto-correlations and power density curves. The character of the instabilities was studied by means of a multistage impedance void detector. The onset of instabilities is presented as a function of pressure and inlet subcooling. Particular flow patterns observed in an atmospheric boiling loop are shown. (auth)

10226 (EURAEC-858) A NEW MODEL OF TWO-PHASE FLOW IN VERTICAL BOILERS. Special Technical Report No. 12. F. van der Walle, H. J. Lamein, C. L. Spight, and M. Bogaardt (Eindhoven, Netherlands. Technische Hogeschool). Sept. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 032-60-11-RDH. 15p.

A model describing heat transfer and fluid flow in vertical boiling channels is derived from first principles. The general flow equations are formulated for the unsteady case. The theoretical model ascribes the increase in frictional pressure drop and heat transfer to an increased turbulence level due to a relative movement of the vapor bubbles with respect to their surroundings. After the introduction of dimensionless parameters, it is found that 8 similarity parameters govern the solution of the exact equations. Some general conclusions are drawn regarding friction loss and burnout heat flux. By introduction of prescribed radial distributions, the set of partial differential equations is reduced to a set of ordinary differential equations that can be solved numerically without too much difficulties. (auth)

10227 (GEAP-4429) A PROGRAM OF TWO-PHASE FLOW INVESTIGATION. Third Quarterly Report, October–December 1963. F. W. Staub and N. Zuber (General Electric Co. Schenectady, N. Y. and General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Work Performed under Joint United States–Euratom Research and Development Program. Contract AT(04-3)-189. 42p. (EURAEC-945)

The design, development, and modification of a heat transfer loop for studying two-phase flow are described. The system is charged with Refrigerant-22. The design and construction of the test section and stand are complete and preliminary testing is finished. Pressure and temperature instrumentation for the test section is complete. The x-ray power supply and the power supply for the test section are being completed. The analysis of the set of equations which describe the dynamic response of the two-phase mixture are being continued. (N.W.R.)

10228 (HW-80523) BOILING BURNOUT EXPERIMENTS WITH FOG-COOLED NINETEEN-ROD BUNDLE TEST SECTIONS. G. M. Hesson, D. E. Fitzsimmons, and J. M. Batch (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 27, 1964. Contract AT(45-1)-1350. 44p.

Heat transfer experiments were made with electrically heated models of a 19-rod bundle fuel element under boiling burnout conditions. The experiments were made at coolant flow rates of 5×10^5 to 2×10^6 lb/hr-ft^2 and inlet steam

qualities of 0 to 30%. The results are compared with these of other experiments. An inverse mass flow effect was observed, with a possible cross-over to a direct mass flow effect at outlet qualities of ~10%. A discontinuity in the burnout heat flux-exit enthalpy relation was observed at 5×10^5 lb/hr-ft^2 and attributed to nonsteady flow. (D.L.C.)

10229 (KR-62) AN ANALYSIS OF SLIP IN GAS-LIQUID FLOW APPLICABLE TO THE BUBBLE AND SLUG FLOW REGIMES. L. G. Neal (Norway. Institutt for Atomenergi, Kjeller). Dec. 1963. 23p.

Beginning with the notion that slip in two-phase (gas-liquid) flow is a result of two effects (the difference in the gravitational forces acting upon the phases, and the existence of radial gradients of void fraction and stream velocity), equations are derived which can be used to calculate the slip velocity ratio. The model introduces two flow parameters: the first is a correlation coefficient between the void fraction and mixture velocity, and the second is a measure of the resistance to gas motion with respect to the liquid. The equations predict correctly the experimentally observed variations of the slip velocity ratio with void fraction (or quality) and circulation velocity. Further, although a complete evaluation of the model must await the measurement of local two-phase properties, in comparing the equations with various data from the literature it is found to be consistent and well within the scatter of the experiments. (auth)

10230 (NAA-SR-8514) EXPERIMENTAL STRESS ANALYSIS OF 37-TUBE MODULAR STEAM GENERATOR HEAD. M. M. Lemcoe (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 30, 1964. Contract AT(11-1)-Gen-8. 19p.

The results of an experiment conducted to determine the stresses at certain critical locations on a 37-tube modular steam generator head, designed for operation at pressures up to 4000 psi and temperatures up to 1100°F maximum are reported. Favorable results of this experiment indicate feasible operation at the design parameters, and lead to the conclusion that a 61-tube head should be possible of construction. (auth)

10231 (NAA-SR-9010) INPILE EXPERIMENTAL STUDIES OF TRANSIENT BOILING WITH ORGANIC REACTOR COOLANT. P. Spiegler, J. Hopenfeld, M. Silberberg, and C. F. Bumpus, Jr. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 30, 1964. Contract AT-11-1-GEN-8. 88p.

Results of an experimental and analytical program conceived to yield data and information on transient void formation in an organic cooled reactor undergoing a rapid power transient is presented. The important results of the study are: transient boiling is only an effective shutdown mechanism for bursts and periods longer than about 30 msec, the temperature overshoot at the onset of boiling is primarily dependent on the surface roughness of the heater, and the posttransient heat transfer analysis can be evaluated by existing steady-state boiling heat transfer models. Results of an experiment that simulates conditions under which considerable fuel melting occurs in the reactor are also presented. (auth)

10232 (TID-20046) HEAT TRANSFER AND HYDRAULIC STUDIES FOR SNAP-4 FUEL ELEMENT GEOMETRIES. Topical Report No. 3. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). Jan. 8, 1964. Contract AT(30-3)-187. 32p.

An evaluation is being conducted of the thermal and hydraulic characteristics of a high-performance boiling water reactor, using electrically heated wire-wrapped 12-rod bundles. The test operation of Test Sections No. 3 and 4 is described. Higher burnout heat fluxes were obtained on the high power rods for the same mass velocities and exit steam qualities than for the uniformly heated test sections. (D.L.C.)

10233 (AEC-tr-6290) METHODS OF CALCULATING CRITICAL HEAT FLUXES FOR A FORCED FLOW OF WATER. M. E. (Ye.) Shitsman. Translated from Teploenerg., 10: No. 8, 76-8(1963). 6p.

The effects of mass flow rate on the critical heat flux q_{cr} are discussed. For surface boiling, $q_{cr} = q_0 + \epsilon q_{conv}$, where q_0 = critical heat flux at zero steam content, q_{conv} = convective heat flux, and ϵ = correction for the effect of surface boiling on convection. The results of the calculations were compared with a large number of experimental data; most of the deviations were less than ±15%. For developed boiling, q_{cr} is best expressed in terms of the length of the steam-generating section l_0: $q_{cr}/q_0 = 1/[1 + K(l_0/d_{equiv})^{0.8}]$, where $K = 2.2\, d_{equiv}^{0.8} \exp[1/(1-p_{cr}/p)]$. The experimental points differ from the calculated results by about ±10%. A nomogram is given for determining q_{cr} for different variables at 100 atm abs. (D.L.C.)

10234 (AEC-tr-6303) FLOW MEASUREMENTS CARRIED OUT IN FRANCE BY MEANS OF RADIOACTIVE TRACERS BY THE INTEGRATION METHOD. J. Guizerix, G. Grandclement, R. Hours, H. Andre, R. Wolf, and R. Perez. Translated from p.255-81 of "Proceedings of the Symposium on Radioisotopes in Hydrology, held in Tokyo, March 5-9, 1963" (a publication of the International Atomic Energy Agency, Vienna, 1963). 39p. (STI/PUB/71(p.255-81))

Experiments with the total count method in measuring the discharges of rivers and of hydroelectric plant penstocks are described. The procedure was to sample a portion of the current during the passage of the activity wave by means of gages and constant-level tanks. The sample and an aliquot part of the injected activity are counted in the same geometry. This method has several advantages over the conventional method using a submerged probe. First, it avoids the difficulties presented by the counting geometry, both in rivers and in penstocks; it likewise makes it possible to determine the statistical counting accuracy and, by making several samplings in the measurement section, to verify whether good mixing conditions are present. Furthermore, since it allows the use of a scintillation counter and concentration of the tracer by chemical means, the method, by comparison with the conventional technique, requires a minimal activity to yield a given degree of accuracy. In conclusion, results of measurements of discharges of rivers and penstocks and views on the future of the total count method are given. (auth)

10235 THE DYNAMICS OF VAPOUR BUBBLES IN NUCLEATE BOILING. R. Darby (LTV Research Center, Dallas). Chem. Eng. Sci., 19: 39-49(Jan. 1964).

A photographic study of the growth and translational characteristics of vapor bubbles issuing continuously from a single nucleation site was made for two fluids: water and Arcton (Freon) 113. The liquids were heated uniformly by external radiation to various levels of superheat, where high-speed photographs were taken of the vapor bubbles as they grew on the horizontal surface of a solid body immersed in the liquid, and after detachment while rising a distance of several diameters from the site. The film was analyzed to determine the bubble radius and distance from the nucleation site as a function of time. The bubble radius was found to vary as (time)$^{\frac{1}{2}}$ during the entire recorded history, for all runs. This dependence is reflected in the

dimensionless correlation: $N_{Nu} = 0.088(N_{Re}N_{Pr})^{\frac{1}{3}}$, which accurately represents all data for both liquids, to within 10%, when the velocity parameter is taken to be: $[(\rho L - \rho_v)g\sigma/\rho_v^2]^{\frac{1}{4}}$. The bubble trajectories within the range of observation could be accurately predicted by a balance of buoyancy with inertial and viscous forces. (auth)

10236 SUMMARY OF EXPERIMENTS ON A TRANSPIRATION-COOLED ELECTRIC-ARC HEAT-TRANSFER SYSTEM. R. B. Kinney, E. M. Sparrow, and E. R. F. Winter (Univ. of Minnesota, Minneapolis). J. Heat Transfer, 86: 131-2(Feb. 1964).

An experimental study of a transpiration-cooled electric-arc heat-transfer device is summarized. The basic element of the apparatus is a porous graphite anode, fabricated from 48% porous graphite, with a mean pore diameter of 0.0013 in. The arc is struck between a tungsten rod-type cathode and the porous anode. Under operating conditions, a gas flows through the porous anode, thereby serving as an effective coolant. Upon emerging into the bore of the anode, the transpiring gas is heated by the arc and is at the same time turned so that it takes on a longitudinal flow direction. The heated gas stream emerges from the device as a coherent, stable jet. The jet is made up entirely of the transpiring gas; no secondary gas stream is employed. The efficiency η with which the electrical input is converted into useful heat energy of the gas usually falls between 80 to 90% at high blowing rates. (P.C.H.)

10237 HEAT-TRANSFER STUDIES OF WATER FLOW IN THIN RECTANGULAR CHANNELS. PART I. HEAT TRANSFER, BURNOUT, AND FRICTION FOR WATER IN TURBULENT FORCED CONVECTION. W. R. Gambill and R. D. Bundy (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 18: 69-79(Jan. 1964).

Experimental determinations were made of friction factors, burnout heat fluxes, and average and local nonboiling heat-transfer coefficients for forced-convection flow of water through thin aluminum and nickel rectangular channels under the following conditions: heat flux = 0.1×10^6 to 7.4×10^6 Btu/h · ft^2, velocity = 10 to 85 ft/sec, Reynolds number = 9,000 to 270,000, pressure = 1 to 39 atmospheres absolute, flow gap = 0.043 to 0.057 in., and heated length = 12 and 18 in. A few tests were made to ascertain the effect of an axially oriented cylindrical spacer strip on surface-temperature distribution and burnout heat flux. The results of these studies, unlike those of some earlier investigations of narrow-gap heat transfer, are in reasonably good agreement with accepted correlations. The friction factors are in satisfactory agreement with the Moody chart for the relative roughness of the test sections used, the burnout heat fluxes are well reproduced by the Soviet Zenkevich-Subbotin correlation, and the local and average heat-transfer coefficients are slightly larger than values predicted by the Hausen and Sieder-Tate equations. (auth)

10238 HEAT-TRANSFER STUDIES OF WATER FLOW IN THIN RECTANGULAR CHANNELS. PART II. BOILING BURNOUT HEAT FLUX FOR LOW-PRESSURE WATER IN NATURAL CIRCULATION. W. R. Gambill and R. D. Bundy (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 18: 80-9(Jan. 1964).

Twenty-nine experimental determinations of burnout heat flux were made with water flowing by natural circulation through electrically heated vertical tubes with and without internal twisted tapes and through rectangular cross sections of three aspect ratios. Heated lengths varied from 10 to 33 in., system pressure at the test-section flow exit from 14.7 to 26.3 lb/in.^{2}abs, inlet subcooling from 36 to 170°F, and burnout heat flux from 13,000 to 218,500 Btu/h · ft^2. Tests were made with both unrestricted and restricted return flow paths. Three correlations were developed for predicting natural-circulation burnout heat fluxes for such conditions. Two are useful for rapid estimation, but the third involves a more fundamental assessment of the coolant-mass velocity at burnout by a graphical matching of the heat flux that a given flow rate can sustain to the heat flux that will produce that flow rate. For all the data, this approach gave average and maximum deviations of 15 and 38%, respectively. It was found that use of a slip ratio of unity is adequate for burnout prediction, and the reasons for this are discussed in detail. The small burnout penalty incurred by a substantial restriction of return flow path, experimentally observed, is in accord with the theoretical model. (auth)

10239 MORE ON DNB DATA. John S. Wiley (General Nuclear Engineering Corp., Dunedin, Fla.). Nucleonics, 22: No. 2, 6; 68(Feb. 1964).

Statistical fluctuations of experimental fuel-element burnout data from a correlation curve are related to the statistics of how the individual experimenter makes tests and plots data. Examples, taken from AEC report WAPD-188, include steam energy flow plots for different subcoolings. (R.E.U.)

10240 CONDUCTING FLUID FLOW OVER A POROUS SURFACE IN THE PRESENCE OF A HETEROGENEOUS MAGNETIC FIELD. S. A. Regirer. Prikl. Mat. i Mekhan., 27: 1095-9(Nov.-Dec. 1963). (In Russian)

An analysis was made of incompressible hydromagnetic, viscous flow in channels with porous walls in the presence of heterogeneous magnetic fields. (R.V.J.)

10241 GENERAL PRINCIPLES OF MAGNETO-FLUID DYNAMICS. Isao Imai (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), Suppl., No. 24, 1-34(1962).

The fundamental equations of magnetohydrodynamics are presented. Properties of a magnetic field are outlined. The steady motion of an inviscid, compressible, perfectly conducting fluid in the presence of an aligned magnetic field and hydromagnetic waves are considered. Approximation methods are also given. (C.E.S.)

10242 INCOMPRESSIBLE FLOWS IN MAGNETO-FLUID DYNAMICS. Hidenori Hasimoto (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), Suppl., No. 24, 35-85 (1962).

Fundamental equations, boundary conditions, exact solutions, and reducible problems are given for incompressible flow in magnetohydrodynamics. Magnetohydrodynamic wakes and flow at low and high Reynolds numbers are also considered. (C.E.S.)

10243 MAGNETO-FLUID DYNAMICAL CHANNEL FLOWS. Ken-ichi Kusukawa (Tokyo Metropolitan Univ.). Progr. Theoret. Phys. (Kyoto), Suppl., No. 24, 86-102 (1962).

Formalism is presented for Hartmann flow, steady flows of conducting fluids in straight channels with arbitrary cross section, Ohm's law for ionized gases, and the Hall effect in the viscous flow of ionized gases through straight channels. (C.E.S.)

10244 MAGNETO-FLUID DYNAMICAL INVISCID FLOWS. Ken-ichi Kusukawa (Tokyo Metropolitan Univ.). Progr. Theoret. Phys. (Kyoto), Suppl., No. 24, 103-41 (1962).

Fundamental equations for the magnetohydrodynamics of inviscid fluids are presented. Two- and three-dimensional flow past thin bodies, unsteady motions, and general theory are considered. (C.E.S.)

10245 MAGNETO-FLUID DYNAMICAL SHOCK WAVE. Akira Sakurai (Tokyo Electric Engineering Coll.). Progr. Theoret. Phys. (Kyoto), Suppl., No. 24, 142-55(1962).

Conditions relating quantities on the two sides of a shock wave in a conducting gas, the propagation of shock waves, and the configuration of a shock wave formed in front of a body in steady flow are considered. (C.E.S.)

10246 MAGNETO-FLUID DYNAMICAL STABILITY AND TURBULENCE. Tomomasa Tatsumi (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), Suppl., No. 24, 156-92 (1962).

The effect of the magnetic field on the stability of laminar flow is considered. It is shown that laminar flows are always stabilized by a uniform magnetic field parallel to the flow, but they may be destabilized by other types of fields. Evidence is presented to show that the conductivity of the fluid acts as a stabilizing agent so long as it is small and reversely if it is large. For large values of the conductivity there exists a critical intensity of the magnetic field above which the flows are completely stabilized against all infinitesimal disturbances. Magnetohydrodynamic turbulence in which the fluctuations in the velocity and the magnetic field are not small in comparison with their mean values are also investigated. It is shown that the effect of the uniform magnetic field is stabilizing and, turbulence decays more rapidly in the presence of the magnetic field. Homogeneous magnetohydrodynamic turbulence in the absence of a mean magnetic field is discussed with emphasis on energy balance between the kinetic and magnetic components of turbulence. (C.E.S.)

10247 ZHIDKIE METALLY. SBORNIK STATEI. (Liquid Metals. Collection of Articles). V. M. Borishanskogo, S. S. Kutateladze, V. L. Lel'chuka, and I. I. Novikova, eds. Moscow, Gosatomizdat, 1963. 327p.

A collection of articles on liquid metal heat transfer agents is divided into four parts. The first part covers the theoretical aspects of thermal problems related to liquid metal flow through tubes and channels. The second deals with experimental data on heat transfer and hydraulic resistance of liquid metals in tubes. The third part is devoted to heat transfer intensification in boiling mercury. The fourth part discusses physical and physicochemical properties of liquid metals and reactions with construction materials. Problems connected with liquid metal cooling system operation are also discussed. (R.V.J.)

10248 INVESTIGATION OF ENERGY TRANSFER IN A TUBE ARC HEATER (thesis). James Gary Skifstad (Purdue Univ., Lafayette, Ind.). 102p. (CONF-363-4)

From International Symposium on Plasma Phenomena, San Diego, Calif., Oct. 1963.

The mutual interaction of an electric arc and a gas flow passing concurrently through a cylindrical tube is investigated. The problem considered is that of analyzing the flow and energy transport processes near the inlet region of the tube, under conditions where the diameter of the region containing the gas heated by the arc discharge is smaller than the diameter of the tube. Experimental data are presented for a tube, $\frac{3}{8}$ inch in diameter, wherein helium gas is heated to bulk stagnation enthalpies above 20,000 B/lb. The data include the axial distributions of the heat flux to the tube wall, the potential distribution along the arc, the total voltage and current of the arc, and the distributions of the properties of the jet measured of a probe. An analysis of the flow and energy transport phenomena, based on the recent methods of laminar flow theory, is presented. The methods yield a system of simultaneous ordinary differential equations describing the flow field. Numerical computations are included. (auth)

Materials Testing

10249 (CONF-310-3) EDDY-CURRENT COIL IMPEDANCE CALCULATED BY A RELAXATION METHOD. C. V. Dodd and W. E. Deeds (Oak Ridge National Lab., Tenn.). [196?]. Contract [W-7405-eng-26]. 20p.

From Symposium on Physics and Nondestructive Testing, San Antonio, Oct. 1963.

A relaxation technique is used to calculate the impedance of a cylindrical eddy-current probe coil. Comparison of impedances calculated by this method with actual impedance measurements shows agreement within the limit of experimental errors. The method also provides information on vector field variations in and around the metal. (D.C.W.)

10250 (SWRI-1296-6-8) DEVELOPMENT OF NONDESTRUCTIVE TESTING INSTRUMENTATION FOR REACTOR PRESSURE VESSELS. Fourth Quarterly Report, October 1, 1963–January 1, 1964. Warren J. McGonnagle (Southwest Research Inst., San Antonio). Jan. 10, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1243. 26p. (EURAEC-948)

A program is being developed for nondestructive testing of the shift in the nil ductility transition temperature of reactor grade steels. The first phase is directed toward simulating the shift in nil ductility transition temperature resulting from metallurgical mechanisms rather than radiation effects. The first technique employed is cold rolling which produces significant changes in the transition temperature with no obvious grain growth. The electric conductivity of A212 Grade B steel is measured using a Kelvin Wheatstone bridge. Specimens of A212 and A302 Grade B steel are prepared for irradiation and are now being irradiated in the LITR. Charpy specimens made from A302 Grade B steel with various degrees of cold work are ready for impact testing. The hot laboratory is described for the tests. The Pl-2 Riehle impact machine is calibrated using standard specimens. Improvements to the ultrasonic attenuation measurement techniques and equipment are described. The magnetic inspection system was improved by the development of electonic equipment, Hall probes, magnetizing equipment, and scanning equipment. (N.W.R.)

10251 HYPERVELOCITY IMPACT OF RADIOACTIVE PROJECTILES INTO STAINLESS STEEL AND ALUMINUM. R. F. Rolsten (California Western Univ., San Diego) and R. A. Schmitt. J. Appl. Phys., 34: 3010-12(Oct. 1963).

Radioactive, cylindrical, steel projectiles were explosively accelerated into plates of stainless steel and aluminum. The amounts of radioisotopes Fe^{59} and Cr^{51} in the projectile prior to acceleration and in the crater in plate were measured in order to determine the fraction of the original projectile remaining in the crater. Impact experiments with steel plates showed that 3.4 to 7.8% of the original projectile remained in the crater of the steel plate; 3.6 to 7.5% of the original projectile remained in the crater of the aluminum plate. Data on any given crater, obtained by the measurement of both Fe^{59} and Cr^{51}, are in good concordance. The fraction of the projectile remaining in the crater is independent of the impact velocity over the range of 12000 to 14900 ft/sec (3600 to 4540 m/sec). (auth)

10252 A POLAROID FILM METHOD FOR TRANSFER NEUTRON RADIOGRAPHY. Harold Berger, I. R. Kraska,

and R. E. Dickens (Argonne National Lab., Ill.). Nucl. Sci. Eng., 18: 137-8(Jan. 1964).

A Polaroid film method for transfer neutron radiography that can be used when the inspection object is highly radioactive, is described. The neutron-image-detection method makes use of a screen of potentially radioactive material. The screen becomes radioactive and is then allowed to decay on photographic film. (C.E.S.)

10253 BURST TEST RESULTS SIMPLIFY DESIGN OF IRRADIATION CAPSULES FOR EXPLOSIVE MATERIALS. A. Mackenzie and E. W. Dalrymple (Picatinny Arsenal, Dover, N. J.). Nucleonics, 22: No. 2, 85-7(Feb. 1964).

The strength of cylindrical pressure vessels subjected to dynamic loads was investigated to provide design data for small irradiation capsules for unstable or chemically reactive materials to be included in reactors or near accelerators. An empirical approach was taken to learn how a mass of detonating explosive can be contained completely in a pressure vessel, what vessel diameter and wall thickness are required, and how these depend on the material strength. C4 explosive was detonated within extruded aluminum 6061 cylinders. (R.E.U.)

10254 PROCEEDINGS OF THE SYMPOSIUM ON PHYSICS AND NONDESTRUCTIVE TESTING. OCTOBER 1, 2, AND 3, 1963, SAN ANTONIO, TEXAS. San Antonio, Texas, Southwest Research Institute, 1963. 391p. $20.00.

Separate abstracts were prepared for 5 of the 18 papers presented; 2 were previously abstracted in NSA. Fundamental principles rather than applications are emphasized. The five sessions include physics of failure, ultrasonics, the Mössbauer effect, radiation inspection, and properties of materials. (R.E.U.)

For abstracts of individual papers see: 10024, 10255, 10256, 10257, and 10660.

10255 THE MÖSSBAUER EFFECT. C. W. Kocher. p.146-65 of "Proceedings of the Symposium on Physics and Nondestructive Testing." San Antonio, Texas, Southwest Research Institute, 1963.

The nucleus-environment interaction is discussed. The interaction of the nuclear and material properties to give the characteristic Mössbauer spectra is discussed, and selected examples are given. The use of the Mössbauer effect as a probe for material properties is considered. The capabilities and limitations of the Mössbauer effect are discussed. 25 references. (R.E.U.)

10256 SOME APPLICATIOI OF THE MÖSSBAUER EFFECT. L. M. Epstein (Westh.ghouse Electric Corp., Pittsburgh). p.166-92 of "Proceedings of the Symposium on Physics and Nondestructive Testing." San Antonio, Texas, Southwest Research Institute, 1963.

The Mössbauer effect was used to study the annealing of steel. The micro-environment of a Mössbauer nuclide in a nonmagnetic material was investigated from quadrupole splitting and isomer shift. Results are given for ionic solids and for chemical bonding in complex ions and molecular solids. Applications of the Mössbauer effect as an environmental sensor, for velocity measurements, to determine gamma-ray polarization, and in radiography are proposed. (R.E.U.)

10257 APPLICATIONS OF BACKSCATTERED RADIATION. Raymond R. Nydegger (Southwest Research Inst., San Antonio, Tex.). p.235-58 of "Proceedings of the Symposium on Physics and Nondestructive Testing." San Antonio, Texas, Southwest Research Institute, 1963.

The types of radiation used in backscatter investigations, the resulting phenomena, and the detection of the resultant radiations are discussed. An analysis of radiation backscattering is presented. The applications, capabilities, and disadvantages of this technique of nondestructive testing are discussed. 24 references. (R.E.U.)

10258 QUALITY CONTROL AND SERVICE PERFORMANCE. Helmut Thielsch. 45p. (CONF-102-32)

From American Society of Mechanical Engineers 1963 Winter Meeting, Philadelphia, Nov. 1963.

Quality control requirements applicable to materials specifications, fabrication specifications including welding, heat treatment, and cleaning, and final inspection specifications are discussed. (P.C.H.)

Protective Structures

10259 (AD-405709) SHELTER CONFIGURATION FACTORS (ENGINEERING AND COST ANALYSES). (Panero (Guy B.) Engineers, New York). Apr. 15, 1963. Contract OCD-OS-62-108. 269p.

Shelter shapes and sizes that appear to offer the best compromise for standardizing new shelter design are described. The study had the following general conditions and criteria: (1) below-ground, single-unit structures with a minimum of three feet of earth cover such as might be constructed under parks or playgrounds; this will result in radiation protection factors of 1000 or more; (2) consideration of both fallout and blast shelters; fallout shelters to be designed on a nominal live-load basis and blast shelters to be designed at 35 and 60 psi overpressure; (3) an extended shelter occupancy time and a closure capability of up to 24 hours; (4) protection against the induction of chemical, biological and radiological contaminants; and (5) single-unit capacities of 100, 500, and 1000 persons each with a 5-minute loading capability. (auth)

10260 (AD-428283) FAILURE MODES OF IMPACT-LOADED FOOTINGS ON DENSE SAND. Technical Report R-281. L. W. Heller (Naval Civil Engineering Lab., Port Hueneme, Calif.). Jan. 27, 1964. 31p.

The design of foundation elements for protective structures which will resist the effects of nuclear weapons often requires predicting the response of a footing-soil system to impact or transient-type loads. This response has been, and continues to be, studied and reported by several governmental and institutional organizations who have recognized that the failure mode of the system is an important parameter in establishing a rational procedure to predict the response of a footing to an impact load. This report reviews the current (1 July 1963) literature, summarizes the various static and dynamic failure modes observed by several investigators, presents an analytical technique which explains the observed failure modes, suggests that the failure mode is dependent upon the footing acceleration during the impact loading, and defines the limiting footing accelerations associated with the two major failure modes. (auth)

10261 (DASA-1386) COMPUTATION OF UNDERGROUND STRUCTURAL RESPONSE. Final Report of a Research Program. Alfredo Ang and Nathan M. Newmark, eds. (Illinois. Univ., Urbana). June 1963. Contract DA-49-146-XZ-104. 237p. (AD-411261)

Means of obtaining a better understanding of the phenomenological aspects of wave propagation in solid media were sought. Such information is of immediate importance in the study of earth motions resulting from blast loadings and in the design of underground structures to resist blast pressures. The research work was carried out in three separate study areas as follows: (1) A theoretical study of wave

propagation in continuous solid media, involving rigorous mathematical formulations of wave motions and shock phenomena in solids. (2) Development of mathematically consistent discrete models of solid continua for the high-speed numerical computation of wave motions in solid media and for evaluating structure-soil interactions. (3) Studies of structure-soil interactions by simple analytical and experimental models. Only the effect of arching was considered. (auth)

Vacuum Engineering

10262 VACUUM SYSTEMS IN DYNAMIC TEST EQUIPMENT DESIGNED FOR STUDIES OF ENGINEERING PROPERTIES OF MATERIALS DURING EXPOSURE TO NUCLEAR REACTOR RADIATION. O. H. Hill, E. E. Kerlin, and E. T. Smith (General Dynamics/Fort Worth, Tex.). 54p. (CONF-209-21; FZM-2911)

From American Vacuum Society Meeting, Boston, Oct. 1963.

An experimental assembly was developed for simultaneously simulating the nuclear reactor radiation and vacuum environments to which engineering materials will be subjected during service in nuclear-powered space vehicles during flights extending to altitudes of 150 miles. Vacuum systems accepting gas loads exceeding 3000 liters/sec at 10^{-6} torr were designed and constructed for dynamic studies of the engineering properties of materials during exposure to radiation from the Ground Shield Test Reactor. The operational characteristics of the systems, growth capabilities, shielding requirements, and associated hardware for dynamic monitoring of sample weight loss, lubricant efficiency, and moduli properties of materials, together with the engineering experience accumulated to date, are discussed. (auth)

GEOLOGY AND MINERALOGY

General

10263 (AD-404012) TENDRAC. World-Wide Standard Station Seismic Measurements [of] VELA UNIFORM Project 173-7. (Coast and Geodetic Survey, Washington, D. C.). Dec. 7, 1962. 46p.

An analysis is presented of seismic data recorded from the TENDRAC event at Nevada Test Site by the standard stations and other stations. Travel times, periods, maximum ground motions, maximum amplitudes, collapse data, and epicenter determinations are given. (D.L.C.)

10264 (AD-407430) ANTLER. World-Wide Standard Station Seismic Measurements of VELA UNIFORM Project 173-7. (Coast and Geodetic Survey, Washington, D. C.). Sept. 15, 1961. 36p.

This report comprises an analysis of seismic data recorded from the ANTLER event at the Nevada Test Site (NTS) by Coast and Geodetic Survey and other stations. These, and other data, will be used by VELA-UNIFORM participants for studies directed toward the development of methods for distinguishing between explosion and earthquake seismic sources. (auth)

10265 (NP-13586) STONES. Long Range Seismic Measurements of VELA UNIFORM Project 8.4. Technical Report No. 63-126. (Geotechnical Corp., Garland, Tex.). May 22, 1963. 33p.

Seismic data and their analysis are presented for the STONES underground nuclear test. The data will be used in conjunction with other data for the development of methods for distinguishing between explosive and earthquake sources. (D.L.C.)

10266 SULFUR ISOTOPIC COMPOSITION OF THE TRIASSIC IGNEOUS ROCKS OF EASTERN UNITED STATES. W. G. Smitheringale (Memorial Univ. of Newfoundland, St. John's, Can.) and M. L. Jensen. Geochim. Cosmochim. Acta, 27: 1183-1207(Dec. 1963).

Mass spectrometric measurements were made of the isotopic composition of sulfur in troilite from meteorites and in sulfides from igneous rocks and genetically associated mineral deposits of the Triassic Newark group, in eastern United States. Some of the intrusives sampled are strongly differentiated. The igneous rocks are tholeiitic, and presumably originated in the upper mantle. Considering the probable isotopic inhomogeneity of sulfur in the many rock types underlying the Newark basins, the observed isotopic uniformity of sulfides in normal diabase from intrusives suggests little contamination with crustal sulfur. The following δS^{34} per mil values were obtained: meteoritic troilite — average $+0.2 \pm 0.1$; normal diabases from intrusives — average $+0.1 \pm 0.4$; late stage facies from differentiated intrusives — mostly +3 to +8, maximum +11, with purite enriched in S^{34} relative to coexisting chalcopyrite; specimens from the Cornwall, French Creek, and Dillsburg deposits, formed from emanations from adjacent diabase intrusives, — range from −0.2 to +17, averaging about +7; extrusives — range from −12 to +0.7, averaging about −5. The standard deviation analytical error is ±0.2. Data are calculated relative to Cañon Diablo troilite with an assumed S^{32}/S^{34} ratio of 22.220. From these data, it was concluded that: beneath the Newark basins, during late Triassic time, upper mantle sulfur was isotopically similar to meteoritic sulfur; isotopic fractionation can occur during crystallization of tholeiitic magma, resulting in a slight enrichment of S^{34} in late stage sulfides; fractionation may continue into hydrothermal stages, causing an enrichment of S^{34} in magnetic hydrothermal sulfides; and by some mechanism of isotopic fractionation associated with crystallization at the earth's surface, sulfides in Newark extrusives are slightly enriched in S^{32} relative to the magma source. (auth)

10267 THE SIGNIFICANCE OF LEAD ISOTOPES IN DETRITAL FELDSPAR WITH RESPECT TO CHEMICAL DIFFERENTIATION WITHIN THE EARTH'S MANTLE. C. Patterson and M. Tatsumoto (California Inst. of Tech., Pasadena). Geochim. Cosmochim. Acta, 28: 1-22(Jan. 1964).

On a continental scale, leads in K-feldspars from North America were found to deviate from closed system evolution such that there is an excess of Pb^{206} and, in lesser extent, Pb^{208} that increases as the age of the feldspar decreases. This effect can be shown to result from the transport of uranium and thorium, over long periods in the past, from the interior of the earth to an outer mantle layer that functioned as a source of segments of continental crust that were formed and isolated at different times and locations. The effect is decisive in defining, as a function of time, the rates of transport of uranium, thorium, and lead from the inner mantle to the outer mantle: there was a sharp decrease in the rates of transport of the three elements during the first one hundred m.y. after the earth was formed; during the remaining aeons, lead transport became essentially zero while uranium and thorium transport remained appreciable. The effect also suggests that the bulk of the North American continent was formed during the interval 3500 − 2500 m.y. ago. (auth)

10268 OXYGEN AND CARBON ISOTOPE RATIOS IN COEXISTING CALCITES AND DOLOMITES FROM RECENT AND ANCIENT SEDIMENTS. Egon T. Degens and Samuel Epstein (California Inst. of Tech., Pasadena). Geochim. Cosmochim. Acta, 28: 23-44(Jan. 1964).

The O^{18}/O^{16} and C^{13}/C^{12} ratios of coexisting sedimentary dolomites and calcium carbonates from a variety of environments, modes of formation, and geological ages were measured. The data reflect the processes of dolomitization of calcium carbonates and their subsequent history. Dolomites usually have δO^{18} values characteristic of marine calcium carbonates or values of diagenetically altered marine limestones. Invariably the δO^{18} of dolomite are the same or greater than that of the coexisting calcite. This is in accordance with previously postulated mechanisms based on isotope measurements of hydrothermal and of laboratory synthesized cogenetic calcites and dolomites. The carbon isotope values of the measured carbonates are usually within the range found for marine limestones. (auth)

10269 GEOCHEMICAL DIFFERENTIATION OF THE RARE EARTH ELEMENTS. D. A. Mineev (Inst. of Mineralogy, Geochemistry and Crystal Chemistry of Rare Elements, Academy of Sciences, USSR). Geokhimiya, No. 12, 1082-1100(Dec. 1963). (In Russian)

The regular character of the evolution of the rare earth composition (Ce → Nd, Gd, Dy → Yb → Dy, Gd, Nd → Ce) in successively formed rock types of the metasomatically altered granitoids is the same as in successively crystallized minerals of pegamatites. The possible cause of such evolution of the rare earth composition is the geochemical differentiation of rare earth elements migrating as com-

plex compounds under conditions of regular acidity variations in postmagmatic mineral-forming solutions. (auth)

10270 MOVEMENTS OF RADIOSODIUM (Na^{24}) WITHIN AN ICE-COVERED LAKE. Gene E. Likens and Arthur D. Hasler (Univ. of Wisconsin, Madison). Limnol. Oceanog., 7: 48-56(Jan. 1962).

Sodium-24 was transported horizontally a maximum distance of 15 to 20 m during the first 24 hr of replicated experiments conducted during January of 1960 and 1961 in a small ice-covered lake in northwestern Wisconsin. Subsequent horizontal displacement was somewhat slower but reached a maximum distance of almost 30 m from the release point in 3 days. The dispersal pattern was asymmetrical and different in each of the two experiments. Results indicated that some vertical movement occurred during the experimental periods but was of very low velocity. A crushing device was described for releasing the radioactive solution in deep water. In addition a portable scintillation counting system was developed for measuring radioactivity within the lake. (auth)

10271 FISSION-TRACK AGES AND TRACK-ANNEALING BEHAVIOR OF SOME MICAS. R. L. Fleischer (General Electric Research Lab., Schenectady, N. Y.), P. B. Price, E. M. Symes, and D. S. Miller. Science, 143: 349-51 (Jan. 24, 1964).

The density of tracks from spontaneously fissioning U atoms in mica has been used to make quantitative measurements of geologic ages. In comparison with methods in which ages are derived from measurements of radioactive decay products, the fission track method is much simpler and is usually accurate for micas up to a few hundred million years old. Annealing experiments suggest that high ambient temperatures are responsible for track fading in the older samples. (auth)

10272 RELATIVE CONTRIBUTIONS OF URANIUM, THORIUM, AND POTASSIUM TO HEAT PRODUCTION IN THE EARTH. G. J. Wasserburg (California Inst. of Tech., Pasadena), J. F. MacDonald, F. Hoyle, and William A. Fowler. Science, 143: 465-7(Jan. 31, 1964).

Data from a wide variety of igneous rock types show that the ratio of potassium to uranium is approximately 1×10^4. This suggests that the value of $K/U \approx 1 \times 10^4$ is characteristic of terrestrial materials and is distinct from the value of 8×10^4 found in chondrites. In a model earth with $K/U \approx 10^4$, uranium and thorium are the dominant sources of radioactive heat at the present time. This will permit the average terrestrial concentrations of uranium and thorium to be 2 to 4.7 times higher than that observed in chondrites. The resulting models of the terrestrial heat production will be considerably different from those for chondritic heat production because of the longer half life of U^{238} and Th^{232} compared with K^{40}. (auth)

Natural Radioactivity and Fallout

10273 (AD-403276) A CASE STUDY OF RADIOACTIVE FALLOUT. Technical Paper No. 42. Elmar R. Reiter (Colorado State Univ., Fort Collins). Jan. 1963. Contract N189(188)55120A. 35p.

During September 1961 a series of balloon ascents made from Flin Flon, Canada, carrying scintillation counters sensitive to gamma radiation, revealed the existence of shallow stable atmospheric layers carrying radioactive debris, presumably from the Russian test series during the same month. The debris layers encountered on September 14 and 15 have been studied in particular. The debris detected over Flin Flon on September 14, 2221 GCT, at 650 mb had undergone strong sinking motion. One may conclude that it came out of the stratosphere shortly prior to September 13, 12 GCT, entering the troposphere through the stable layer underneath the jet core, sometimes referred to as jet-stream front. Beginning with September 17 a distinct area of radioactive fallout began to appear at the surface over the eastern United States. Some of this debris seemed to be identical with the one detected over Flin Flon, and it apparently was transported by the same jet stream. Part of the fallout is associated with a small collapsing cold dome travelling ahead of this jet stream. (auth)

10274 (DRCL-401) EFFECTS OF GROUND ROUGHNESS ON THE γ DOSE FROM CS^{137} CONTAMINATION. C. E. Clifford (Canada. Defence Research Chemical Labs., Ottawa). Mar. 1963. 18p. (AD-408304)

The effects of ground roughness on the dose observed above a contaminated field were measured with Cs^{137} sources and a concrete ground with a 45 degree sawtooth profile of 6 in. depth. The effect of rough ground was to reduce the dose observed at a height of 1 meter by a factor that varied markedly with the choice of ground roughness and with distribution of contamination. The results indicate that failure to allow for ground roughness could be the main source of error in the determination of radiation hazards near ground level from the aerial survey of a contaminated region. (auth)

10275 (FZM-2822) AERIAL MONITORING SYSTEM STUDY. (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Feb. 27, 1963. Contract OCD-OS-62-275. 273p. (AD-401210)

Flight procedures and design requirements for instrumentation for making aerial radiological surveys were developed. It is concluded that an aerial monitoring system designed with presently available components is not only feasible but also practical to monitor fallout from nuclear incidents. A recommended system which was selected on the basis of cost and response time is described in considerable detail. Radiation fallout patterns, expected number and location of burst points, wind effects, and local anomalies are considered in connection with aircraft range, speed, and basing constraints to develop flight precedures for making a survey of the U.S. or of fallout of a single burst. Sensor design is based upon the capability to measure ground radiation levels between 1 and 1000 r/hr from altitudes above 1000 feet in the presence of airborne activity. Facsimile, teletype, and digital systems are considered for the data system to provide the national center with geographical position and time referenced radiological data with which contour maps can be constructed. (auth)

10276 (PNRO-DEV-119) SUMMARY OF ENVIRONMENTAL RADIOACTIVITY AT THE BETTIS ATOMIC POWER LABORATORY FOR CALENDAR YEAR 1961. (Pittsburgh Naval Reactors Operations Office, AEC). Jan. 11, 1962. 10p.

Measurements of radioactivity in the fallout and the soil, as well as measurements of background radiation intensities at the boundaries of the Bettis Atomic Power Laboratory throughout 1961 showed no evidence that Laboratory processes contributed significant amounts of radioactivity to areas surrounding the Laboratory. Radioactivity released to the Laboratory liquid effluent was considerably below the permissible concentration for drinking water. (auth)

10277 (AEC-tr-6128(p.125-38)) THE MEASUREMENT OF THE EXHALATION OF RADON FROM THE SURFACE

OF CERTAIN TYPES OF ROCKS. T. I. Sisigina. (Translation)

Results are presented of studies of the radon exhalation from the surface of rocks that differ in composition, radioactivity, and density. A comparison of two methods for measuring radon flux is given. Recent deposits without unusual radioactivity have an exhalation on the order of 20 to 50×10^{-18} C/cm^2-sec. The concentration of radon in the ground-level air layer was calculated and found to agree well with observed values. The observations were made in Central Asia in the summers of 1957 and 1958. (D.L.C.)

10278 (AEC-tr-6128(p.312-28)) THE CONTAMINATION OF THE SEAS AND OCEANS BY ARTIFICIAL RADIOACTIVE SUBSTANCES. G. A. Sereda. (Translation)

Most of the radioactive contamination of the world oceans is from explosions of atomic and hydrogen bombs from 1945 to 1958, and only Sr^{90} and Cs^{137} remain in the ocean in a state of solution. The total fallout over oceans is estimated to greatly exceed that over land. Contamination by atomic wastes is also considered. Vertical exchange of water in seas and oceans is discussed. (D.L.C.)

10279 (JPRS-22702(Del.)) THE RADIOACTIVITY OF SOME ORGANISMS IN THE NEMAN RIVER. F. V. Gintovt and O. G. Mironov. Translated from Zool. Zh., 42: 1574-6 (1963). 6p. (p.64-7). (OTS-64-21267(Del.))

Data are presented on the radioactivity of 13 species of fish and 6 species of mollusks caught between Feb. and June, 1961 in the Neman River. (C.H.)

10280 STRONTIUM-90 IN THE SOILS OF THE NEW YORK CITY AREA. J. L. Kulp, A. Kaufman, R. Slakter Hirshman, and A. R. Schulert (Columbia Univ., Palisades, N. Y.). Ann. N. Y. Acad. Sci., 93: 761-74(Sept. 28, 1962).

As a result of nuclear tests through 1958, which probably introduced about 5 megacuries of Sr^{90} into the stratosphere, the deposit in the New York City area reached a maximum of about 70 mC/sq. mile in the summer of 1961. In the New York City area, the ratio of soluble to insoluble Sr^{90} is about 10 : 1. The Sr^{90} concentration decreases exponentially with depth in the soil so that in average soil 70 to 75% of the Sr^{90} is in the upper 2 in. and 90 to 99% is in the upper 6 in. There is no evidence for significant vertical movement of the Sr^{90} after initial deposition over a period of 8 yr. (P.C.H.)

10281 PHYSICS, CHEMISTRY, AND METEOROLOGY OF FALLOUT. Rolf Bjoernerstedt and Kay Edvarson (Research Inst. of National Defence, Stockholm). Ann. Rev. Nucl. Sci., 13: 505-34(1963).

The production, transport, and deposition aspects of fallout that require continued research are reviewed. 125 references. (R.E.U.)

10282 CESIUM-137 AND STRONTIUM-90 IN MILK. K. G. Vohra, U. C. Mishra, B. Y. Lalit, and A. S. Deshpande (Atomic Energy Establishment, Trombay, India). Indian J. Chem., 1: 473-6(Nov. 1963).

Cesium-137 and strontium-90 levels in liquid milk samples from Bombay and 27 other stations in India, and powder milk samples from Australia, Denmark, Holland, India, UK, and the USA were estimated since 1958. Cs^{137} was estimated by gamma spectroscopy using a 10-channel scintillation spectrometer. Sr^{90} levels were measured by chemical separation of strontium from samples of milk and measurement of beta activity on a low level beta counting instrument. The maximum and minimum levels of Cs^{137} in country-wide milk samples for the years 1959, 1960, and 1961 are 159.9 and 3.2, 20.6 and 1.4, and 168.2 and 1.9 $\mu\mu$C/g potassium, respectively; the maximum and minimum levels of Sr^{90} are 32.6 and 0.5, 8.8 and 0.3, and 44.3 and 0.5 $\mu\mu$C/g calcium, respectively. Cs^{137} and Sr^{90} contents of Australian and Indian milk powders are the lowest and of the same order, while the levels for the samples from UK are the highest. The results of the measurements were interpreted on the basis of the rate of fallout of the isotopes, seasonal effects, and other meteorological phenomena. (auth)

10283 HIGHLY RADIOACTIVE PARTICLES IN THE ATMOSPHERE. Antal Simon. Idojaras, 67: 287-9(Sept.-Oct. 1963).

A method is described for determining radioactive particles in the atmosphere. Using the method, 383 m^3 of air was found to contain an average of one hot particle. At the same time, at another place, one particle was found in every 100 m^3 of air by means of an autoradiographic method. The comparison shows that the autoradiographic method is indispensable for the investigation of hot particles. (TCO)

10284 RADIOACTIVE FALLOUT IN CALIFORNIA DURING THE WINTER 1961-2. Paul Kruger, Gerald Hamada, and Albert Miller (Hazleton-Nuclear Science Corp., Palo Alto, Calif.). J. Appl. Meteorol., 2: 608-13 (Oct. 1963).

Collections of nuclear debris in dry and precipitation fallout samples were made during the winter 1961 to 62 at Palo Alto and Santa Barbara, Calif., following resumption of nuclear testing by the USSR. The samples were radiochemically analyzed for the fallout radionuclides Sr^{90} and Sr^{89}. The data show the expected increase in radioactivity levels at each location in precipitation following the Soviet detonations. Palo Alto and Santa Barbara, separated by 300 miles, exhibit close similarity in fallout results. Two interesting changes in fallout concentrations were observed, which may be attributed to meteorological influences. (auth)

10285 WEATHERING OF CAESIUM-137 IN SOIL. H. J. Gale, D. L. O. Humphreys, and E. M. R. Fisher (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 201: 257-61(Jan. 18, 1964). (AERE-R-4241)

The weathering effect over several years for Cs^{137} deposited on a number of types of soil was measured and the observed reduction in dose-rate was correlated with the measured distribution of activity in the soil. The results showed that at the time of sampling (4.8 years after deposition) about 50–80% of the activity is contained in the top 5 cm of soil. After 4.8 years the gamma-dose rate at 50 cm above a small area of soil on which Cs^{137} has been deposited is between 55 and 73% of the initial dose rate for eighteen plots of five different soil types, the average values for the individual soil types lying between 60 and 68%. There was little significant difference between the movement of the activity in the different soils. (P.C.H.)

10286 SPRING PRECIPITATION AND THE STRONTIUM-90 CONTAMINATION OF WHEAT IN THE SEMI-ARID REGIONS OF IDAHO AND MONTANA. W. H. Rickard (General Electric Co., Richland, Wash.). Nature, 201: 309-10(Jan. 18, 1964).

It is speculated that wheat growing in regions experiencing marked spring precipitation should exhibit higher Sr^{90} contents than wheat grown in regions with relatively weak spring precipitation. An inspection of precipitational data and a knowledge of the spring floral development of wheat suggest that wheat grown in eastern Montana might yield a higher Sr^{90} content than Idaho grown wheat. Evidence is given that supports the suggestion that a consid-

eration of ecological phenomena offers a means to evaluate more closely the degree of Sr^{90} contamination of cereal grains grown in semi-arid regions. (P.C.H.)

10287 RADIOACTIVE RAIN, SNOW AND ATMOSPHERIC CONTAMINATION OBSERVED IN NAGAOKA CITY, JAPAN. REPORT VIII. TOTAL INTENSITIES OF THE RADIOACTIVE FALLOUT DURING THE YEAR 1962. Ugoro Kobayashi and Hideho Sasaki (Niigata Univ., Japan). Niigata Daigaku Kogakubu Kenkyu Hokoku, No. 12, 1-5 (Mar. 1963). (In Japanese)

In 1962 the artificial radioactivity of rain, snow, and airborne debris in Nagaoka City due to nuclear detonations was investigated. Because of the interruption of the northern nuclear explosion tests in November 1961, the radioactive fallout diminished month by month until August 1962, but when tests were resumed, it began to increase again and since then has steadily increased. The total amount of fallout from January to October 1962 has already exceeded that of all the year 1958, the highest one till 1961. (auth)

10288 ON RADIOACTIVE GIANT PARTICLES CONTAINED IN RADIATION FALLOUT. REPORT II. Ugoro Kobayashi and Hideo Sasaki (Niigata Univ., Japan). Niigata Daigaku Kogakubu Kenkyu Kokoku, No. 12, 15-23(Mar. 1963). (In Japanese)

Studies were made of radioactive giant particles, and a method of study, their distribution, and some views on the process of extraction and selection of them from other dusts, and on microscopic examination are reported. Several types of the giant particles were noted, so they are classified in their photographs. (auth)

10289 NOTE ON THE INCREASE OF GAMMA RADIATION FROM THE GROUND DURING SEPTEMBER 1st-NOVEMBER 30th, 1961. Rolf M. Sievert (Inst. of Radiophysics, Stockholm). Tellus, 15: 309-12(Aug. 1963).

The method and installations used to register ground-level gamma radiation in Sweden from nuclear weapons testing are described. Seasonal variations are considered in a September 1 to November 30, 1961, report. (R.E.U.)

10290 SOME OBSERVATIONS OF VARIATIONS OF THE NATURAL BACKGROUND RADIATION. Thomas Thompson (Swedish Meteorological and Hydrological Inst., Stockholm) and Per Åke Wiberg. Tellus, 15: 313-18(Aug. 1963).

Variations in ionization in high-pressure ionization chambers are correlated to precipitation at 25 sites in Sweden. Various factors influencing the natural radioactivity (Ra^{226} series) of precipitation are discussed. The average specific activity is calculated. (R.E.U.)

Techniques and Equipment

10291 APPLICATION OF RADIOISOTOPES IN HYDROLOGY. PROBLEMS AND RESPECTIVE. Masao Kato (Tokyo Univ.). Genshiryoku Kogyo, 9: No. 8, 10-12(Aug. 1963). (In Japanese)

Requirements and uses of radioactive tracers for water are discussed. Tritium-rich water is a true tracer for water. Under suitable conditions, Br^{82}, Cr^{51}, I^{131}, and Na^{24} also can be used. Applications of radioisotopes to surface waters include the studies of mixing processes and river discharge. Applications to groundwater include the determinations of direction and speed of flow, abundance, and age of groundwater. Quantitative measurements rather than qualitative are now needed in the study of sand and sediment transport. (Nucl. Sci. Abstr. Japan, Vol. 2, No. 4)

10292 TEMPERATURE EFFECTS IN NEUTRON INVESTIGATION OF DEEP AND SUPER-DEEP WELL LOGGING. D. A. Kozhevnikov (Moscow Inst. of Petroleum-Chemical and Gas Industry). Izv. Akad. Nauk SSSR, Ser. Geofiz., No. 12, 1837-41(Dec. 1963). (In Russian)

An analysis of temperature effects on the spatial distribution of thermal neutrons during deep and super-deep well logging showed considerable variations at 250 to 300°C. A maximum temperature effect was encountered in high water-bearing rock and elements with high thermal neutron capture cross sections. (R.V.J.)

10293 ATMOSPHERIC TRITIUM AS A TOOL FOR THE STUDY OF CERTAIN HYDROLOGIC ASPECTS OF RIVER BASINS. Erik Eriksson (International Metrological Inst., Stockholm). Tellus, 15: 303-8(Aug. 1963).

A method is demonstrated for computing the hydrological characteristics of a river basin from a knowledge of added bomb-produced tritium in precipitation and tritium in run-off. It is demonstrated that the characteristics thus computed agree well with the physiography and geology of the basin. (auth)

10294 EXTENSION OF THE AGE DETERMINATION METHOD BY ENRICHMENT OF C^{14} WITH A SEPARATION COLUMN. F. Malota. Thesis, Munich, Universität, 1962. 59p. $2.00(Gmelin, AED-DISS.-62-566).

The sensitivity of age determination with a proportional gas counter can be increased by enriching C^{14} in a separation column and by using a single channel analyzer so that only pulses in the C^{14} energy range are counted. The construction of counting and processing equipment is described. (Gmelin Inst.)

Thorium and Uranium Minerals

10295 A METHOD OF REFINING OF URANIUM ORE IN JAPAN. Hideo Kinoshita (Furukawa Electric Co., Ltd., Japan). FAPIG (Tokyo), 27: 121-7(Aug. 1963). (In Japanese)

An economical method of refining uranium ore in Japan is described. Uranium ore is leached by an aqueous mixture of bicarbonate and oxalate, then extracted from sulfuric acid solution by amine solvent. After the uranium in organic phase is back-extracted by sodium carbonate solution, uranium tetrafluoride is prepared by reducing with sulfurous acid gas, and finally metallic uranium is obtained from uranium tetrafluoride by conventional methods. The use of the mixture of bicarbonate and oxalate for leaching is advantageous for obtaining high-purity leaching solution and a high leaching rate for uranium ore in Japan. The use of oxalate also increases the extraction ratio in the process of extraction by amine. The reducing fluorination with sulfurous acid gas has the following merits: the reducing rate is high, the double salt obtained is easily filtered, and uranium tetrafluoride is easily obtained by thermal decomposition of the double salt. (Nucl. Sci. Abstr. Japan, Vol. 2, No. 4)

10296 THORIUM, URANIUM, AND POTASSIUM CONCENTRATIONS IN HAWAIIAN LAVAS. K. S. Heier (Australian National Univ., Canberra), I. McDougall, and J. A. S. Adams. Nature, 201: 254-6(Jan. 18, 1964).

The contents of K, Th, and U in basaltic lavas in Hawaii were determined. The results show a strong coherence between Th, U, and K exists in most rock types. The concentrations increase with petrogenic evolution, and the relative enrichment is Th > U > K. Some indication exists for a

temporal distribution pattern of Th and U relative to K. The similar (and specific) Th/K and U/K ratios of nepheline basalt and tholeiites on Kauai indicate a derivation from a common source possessing this characteristic ratio rather than a derivation by magmatic differentiation. Data are tabulated. (P.C.H.)

10297 MINING AND REFINING OF URANIUM. Katsuji Higuchi (Japan Atomic Fuel Corp., Tokyo). Nippon Kogyo Kaishi, 79: 612-21(Aug. 1963). (In Japanese)

Better milling procedures have been intensively investigated since the inauguration of Japan Atomic Fuel Corp. (JAFC). As a result, the conversion process has been developed, which eliminated several processing steps by integrating a part of both milling and refining steps. The pilot plant based on the conversion process is scheduled to be constructed at Ningyō-tōge area. JAFC has operated a pilot refinery adopting the Excer process for over four years. Problems associated with the product quality were satisfactorily solved during the first two years. Since then, efforts were mostly devoted to raising the overall recovery of uranium by improving the main circuit and by establishing secondary circuits. At present, it may be said that the pilot refinery is getting close to its mission and waiting to be scaled up. (auth)

10298 OSNOVIYE CHERTY GEOKHIMII URANA. (Principal Characteristics of Uranium Geochemistry). A. P. Vinogradova, ed. Moscow, Publishing House of the Academy of Sciences, 1963. 352p.

Comprehensive data are compiled on uranium geochemistry, atomic structure, ion behavior, crystal chemistry, behavior in magmatic, pegmatite, and hydrothermal processes, geological distribution, and means of prospecting. Extensive references are given at the end of each chapter. (R.V.J.)

HEALTH AND SAFETY

Refer also to abstracts 9960 and 10274.

10299 (AD-401763) A METHOD FOR IMPROVING ACCURACY OF AIR PARTICULATE ACTIVITY MEASUREMENTS. Vol. 21, No. 18. Report No. 387. Clement H. Darby, Jr. (Naval Medical Research Lab., New London, Conn.). Oct. 4, 1962. 13p.

Four members of a nuclear-powered submarine crew were subjected to whole-body gamma radiation tests before they had any known contact with radioactivity or nuclear reactors. They were similarly tested after participating in a 60-day patrol. Preliminary analysis of the two sets of data indicates the absence of any internally deposited radionuclides. It thus appears that air particulate activity at its present levels and under normal operating conditions is well within prescribed conservative limits against external and internal beta radiation. More complete conclusions will be possible after computer analysis of the data. (auth)

10300 (AEEW-M-376) A MODIFICATION TO SELF-CONTAINED COMPRESSED AIR BREATHING APPARATUS TO FACILITATE PERSONNEL DECONTAMINATION. C. W. McDonald (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Nov. 1963. 10p.

A description is given of the modification of a Self Contained Compressed Air Breathing Apparatus to provide extended respiratory protection to grossly contaminated personnel during a decontamination period which may exceed the duration of the Breathing Apparatus air supply. (auth)

10301 (DP-843) STATIC AND IMPACT TESTS ON 15-TON CASK FOR SHIPPING IRRADIATED FUEL. W. I. Thisell (Du Pont de Nemours (E. I.) & Co. Engineering Dept., Wilmington, Del.) and J. W. Langhaar (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Aug. 1963. Contract AT(07-2)-1. 152p.

Results of static and dynamic tests on a lead-shielded steel cask weighing 15 tons and used for rail shipment of radioactive fuel are reported. (auth)

10302 (HW-66266(Suppl.1, Rev.)) HAZARDS SUMMARY REPORT FOR THE HANFORD PLUTONIUM CRITICAL MASS LABORATORY. SUPPLEMENT NO. 1. THE REMOTE SPLIT-TABLE MACHINE. C. R. Richey, E. D. Clayton, R. H. Odegaarden, J. D. White, and W. A. Reardon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1963. Contract AT(45-1)-1350. 58p.

A Remote Split-Table Machine (RSTM) is required for the conduct of critical experiments with PuO_2–hydrogenous compacts in the program of critical mass measurements on Pu solutions in the Hanford Plutonium Critical Mass Laboratory. The hazards of the critical experiments are summarized, and operation limitations for RSTM are presented which will minimize the probability of nuclear incidents. (D.L.C.)

10303 (HW-79652) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD, JULY–SEPTEMBER 1963. R. H. Wilson, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 15, 1963. Contract AT(45-1)-1350. 37p.

Comprehensive surveillance of the occurrence of radioactive materials in air, water, and foodstuffs was continued in the vicinity of the Hanford plant. Gross beta activity in air during the third quarter of 1963 decreased to levels observed prior to USSR weapon tests that started in August 1962. The concentration of I^{131} measured in milk from farms in the neighborhood of the Hanford plant during the third quarter was usually less than 10 pC/l; the maximum found in an individual sample was 136 pC/l which occurred in September following an unplanned release from one of the chemical separations plants. Natural background radiation, with some contribution from world-wide fallout continued to be the primary source of environmental exposure for most people living in the Hanford environs. The largest contribution of radioactive material from the Richland Operation continued to be the highly dilute low level waste in the reactor cooling water discharged to the Columbia River. For persons drinking Pasco sanitary water during the 12-month period ending September 1963, the estimated dose to the GI tract was about 2½% of the applicable limit recommended by the National Committee on Radiation Protection and Measurements (NCRP). Residents of Kennewick using Columbia River water received about one-third as much exposure. Sanitary water for Richland is now supplied by a pumping plant located on the Columbia River that started operation in June 1963. Because Richland's water supply was previously supplied by wells charged from the Yakima River, the estimated dose to the GI tract for the 12 months ending September 1963 was less than 1% of the applicable limit recommended by the NCRP. Radiophosphorus content of fish caught downstream from the reactors was within the expected range and probably constituted the major source of radioisotopes for the few people who eat them in quantity. Exposure from the various sources, summed in a manner that tends to maximize the total dose to an individual, were estimated to be about 10% of the Federal Radiation Council (FRC) guide for the total body, 30% of the FRC guide for a child's thyroid, and about 30% of the NCRP maximum permissible rate of intake for bone-seeking radionuclides. (auth)

10304 (JÜL-139-ST) MEASUREMENT OF RADIOACTIVE AIR CONTAMINATION IN THE ENVIRONMENT OF THE JULICH NUCLEAR RESEARCH CENTER. K. J. Vogt and W. Schroeck-Vietor (Kernforschungsanlage, Jülich, Germany). Oct. 1963. 26p. (CONF-337-4)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The general problems concerning air contamination monitoring in the environment of nuclear plants are briefly discussed. The environmental survey of the Jülich Nuclear Research Center serves as an example to demonstrate which methods can be applied in practice to solve the problems arising in monitoring waste air. (auth)

10305 (MSAR-63-133) FISSION PRODUCT RELEASE AND NUCLEAR SAFETY. (MSA Research Corp., Callery, Penna.). Sept. 30, 1963. 9p.

Summaries are given of results of the following studies of reactor hazards: radionuclide release from high-pressure steam leaks, catastrophic leaks in containment vessels, radionuclide retention in a column of sea water, fission product release during fuel meltdown, and catastrophic blowdown to boiler room and through relief duct work. Experience in supporting technologies is also described briefly. (D.L.C.)

10306 (NYO-9774) THE TRANSPORTATION OF HIGHLY RADIOACTIVE MATERIALS. A Review of Current Research. J. Trueman Thompson (Johns Hopkins Univ., Baltimore). Oct. 1963. Contract AT(30-1)-1477. 26p.

Recognizing the need for a summary of the effort aimed at producing safe and economical shipping casks for high level radioactive materials, there are brought together brief statements of the status of research at several facilities which have made significant contributions. The purposes, accomplishments, and plans for future efforts are recounted together with some findings and conclusions. (auth)

10307 (TID-19108) MATERIAL DECONTAMINATION AT NEVADA TEST SITE. Earl R. Sorom, comp. (Reynolds Electrical and Engineering Co., Inc. Radiological Safety Div., Las Vegas, Nev.). Apr. 1960. Contract AT(29-2)-162 48p.

A decontamination evaluation program was conducted to determine the best methods for removing radioactive contaminants from clothing, skin, rubber goods, metals, and miscellaneous equipment. Results, conclusions, and recommendations are presented. (D.L.C.)

10308 (UCRL-7571) HAZARD CONTROL. Quarterly Report No. 14, July–September 1963. (California. Univ., Livermore. Lawrence Radiation Lab.). 74p.

Materials for thermoluminescent dosimetry and heat-resistant adhesives were investigated, and the buildup of a dose-indicating signal in an apparently discharged dosimeter was studied. The detection efficiencies and probabilities for a site periphery monitoring system were calculated, and a method was devised for calculating the burial depth of airborne particles collected on membrane filters. Also, spectral distributions of D_2O-moderated Pu^{238}–Be neutron sources were obtained by Monte Carlo calculation. Eye protection around lasers was studied. A portable continuous alpha air monitor, a portable high-volume air sampler, a remotely controlled calibration facility for neutron and gamma instruments, and a calibration point check system for Juno survey meters were developed. Additionally, the vapor pressure of Hg was redetermined, and a concrete vault, highly contaminated in a nuclear excursion, was successfully decontaminated. Modifications to the tritium monitor, performance of the dual blower system for glove-boxes, and studies on flooring materials and adhesives are summarized. (D.C.W.)

10309 SOME PROBLEMS IN THE LARGE SCALE HANDLING OF BERYLLIUM. F. B. Crossley (Imperial Metal Industries Ltd., Witton, Birmingham, Eng.). Ann. Occupational Hyg., 6: 89-103(Apr.-June 1963).

The Be-production facility at I.C.I. Metals Division is described in detail. Various techniques and methods of health physics control are discussed. Comparative data are presented covering actual air levels found in various parts of the plant under full operational conditions. The results of experiments to assess the rate of decay of atmospheric Be concentration are also described. (auth)

10310 HEALTH PHYSICS SERVICES AT THE ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL. N. G. Stewart and J. E. Johnston (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Ann. Occupational Hyg., 6: 153-61(July 1963).

The health physics and medical services at A.E.R.E. were developed to meet Harwell's needs as a large establishment whose primary function is to carry out scientific research. The organization which evolved has proved in practice to be a flexible and efficient system for giving advice and help to individual research workers in control of radiation hazards. (auth)

10311 HEALTH PHYSICS SERVICES IN UNIVERSITIES. G. D. Parfitt (Univ. of Nottingham, Eng.). Ann. Occupational Hyg., 6: 163-6(July 1963).

The control of radiation exposure in universities in Great Britain that use radioactive materials is discussed. (C.H.)

10312 HEALTH PHYSICS SERVICES IN HOSPITALS. S. K. Stephenson (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Ann. Occupational Hyg., 6: 167-74(July 1963).

Radiological safety practices in hospitals in Great Britain are reviewed. It is pointed out that the uses of ionizing radiations in hospitals may include both diagnostic and therapeutic applications in the clinical fields, the use of radioisotopes in tracer studies, and radiation sources in research departments associated with the hospitals. Radiological safety in hospitals is governed by a code of practice established in 1957. (C.H.)

10313 THE HEALTH PHYSICS SERVICES PROVIDED BY THE RADIOLOGICAL PROTECTION SERVICE. E. E. Smith (Radiological Protection Service, Sutton, Surrey, Eng.). Ann. Occupational Hyg., 6: 175-80(July 1963).

The health physics services provided by the Radiological Protection Service of Great Britain include the protection of radiation workers in industry, research, and medicine, and the general public when appropriate. Personnel monitoring programs are discussed. (C.H.)

10314 HEALTH AND SAFETY AT A NUCLEAR POWER STATION. G. C. Dale (Central Electricity Generating Board, London). Ann. Occupational Hyg., 6: 181-6(July 1963).

Health physics and safety programs at nuclear power plants in Great Britain are outlined. Special problems at nuclear power plants are discussed. (C.H.)

10315 HEALTH PHYSICS SERVICES IN AN INDUSTRIAL FUEL ELEMENT FACILITY. A. S. Anderson (Rolls-Royce Ltd., Derby, Eng.). Ann. Occupational Hyg., 6: 187-92(July 1963).

Health physics activities at an industrial plant engaged in the manufacture of reactor fuel elements are outlined. Special problems encountered in handling fissionable materials are discussed. (C.H.)

10316 HEALTH PHYSICS SERVICES IN PRIVATE INDUSTRY. H. G. Thurston (Stewarts and Lloyds Ltd., Corby, Northants, Eng.). Ann. Occupational Hyg., 6: 193-7(July 1963).

The health physics program is described for a private industry using radiographic inspection in the manufacture of fabricated pipework. Safety measures for the handling and transport of radioisotopes and also for the use of x-ray equipment used are discussed. (C.H.)

10317 A HEALTH PHYSICS PERSONNEL RECORDS SYSTEM. Hugh D. Evans (Imperial Coll. of Science and Tech., London). Ann. Occupational Hyg., 6: 223-34(Nov. 1963).

A versatile personnel records system is described which is usable for numbers from less than 10 persons up to the point where a punched-card system is necessary. It has been in continuous use for about 3 yr, recording results of film badge tests and blood counts for up to 350 persons and has not so far shown any obvious deficiencies. There is considerable scope for the signalling of a wide range of information. (auth)

10318 DOSE TABLES FOR LINEAR RADIUM SOURCES CALCULATED BY AN ELECTRONIC COMPUTER. M. E. J. Young and H. F. Batho (British Columbia Cancer Inst., Vancouver, Can.). Brit. J. Radiol., 37: 38-44(Jan. 1964).

Tables of dose factors for linear Ra sources were calculated using an electronic computer. The tables give values of a function proportional to the dose-rate at points on a rectangular grid surrounding the source. Each table is applicable to any source of the specified filtration and diameter. The values of the constants used in the calculations are discussed. In particular, the value of the absorption coefficient of Ra γ rays in Pt was taken as a function of the absorber thickness. (auth)

10319 GAMMA-RAY DOSIMETRY OF INTERNAL EMITTERS. MONTE CARLO CALCULATIONS OF ABSORBED DOSE FROM POINT SOURCES. W. H. Ellett, A. B. Callahan, and G. L. Brownell (Massachusetts General Hospital, Boston). Brit. J. Radiol., 37: 45-52(Jan. 1964).

Monte Carlo calculations of the absorbed dose delivered by point source γ emitters to tissue equivalent phantoms were performed and the results are presented in tables that include that fraction of the emitted energy absorbed by the phantom. The use of these tables makes it possible to calculate γ dose-rate in a manner analogous to that used for β-ray dosimetry. (auth)

10320 CONCERNING NUCLEAR PROPULSION OF SHIPS AND CHANCE OR UNFORESEEABLE ACCIDENTS: PRESENT STATUS. F. Le Chuiton and L. Tanon. Bull. Acad. Natl. Med. (Paris), 146: 634-8(Nov. 20-7, 1962). (In French)

Problems and possible control measures relating to the use of atomic power for submarines are reviewed. Important considerations included precise determination of the ratio of the mass of the reactor to vessel's tonnage; adaptability of the reactor required by changes in speed of the ship; detailed study of reactor's structural stability, because of constant motion of the ship in stormy weather; study of eight variations due to such motion and of vibrations produced by propellers. Additional problems considered are possibilities of collision, grounding, icebergs, shipwreck, accidental fire due to reactor breakdown, and waste disposal. Findings are reviewed from a congress that met in London to pool research on safety measures and a Euratom conference in Brussels in 1960 on responsibility in the event of accidents of atomic powered vessels. Data are included from a study of radioactive wastes and their effect on marine flora and fauna. In 1962 a group of experts, meeting in Monaco under the auspices of the International Atomic Energy Agency, reached two opposing conclusions: disposal of all waste radioactive material is potentially dangerous and should be prohibited; and disposal of certain wastes is not dangerous and can be permitted. In the design of ocean-going reactor-powered vessels, it was considered important to adopt a policy of least risk to human life, since the walls retaining radioactive material undergo changes with time and are not entirely leak-proof, and also since unpredictable ocean currents exist. It is concluded that the hazard of marine pollution is limited with improved vessel and reactor construction design, and because collision of submarines is less likely than that of surface ships. (BBB)

10321 SYSTEMATIC SUPERVISION OF THE ATMOSPHERIC RADIOACTIVITY ON THE MAIN FRENCH NUCLEAR SITES IN 1961. A. Doury. Bull. Inform. Sci Tech. (Paris), No. 77, 49-81(Nov. 1963). (In French)

The French nuclear sites are subjected to a systematic atmospheric supervision. The means used and their evolution are reviewed, together with the different organizations involved. The daily detailed results for 1961 are given in their entirety in the form of histograms, and are accompanied by four tables of monthly values for the two years 1961 and 1962. Complementary information is given concerning the composition of the samples (by spectrometry or autoradiography). The results confirm that the overall atmospheric radioactivity is made up essentially of: a constituent of natural origin in which elements of comparatively short half life predominate; and a constituent of artificial origin in which the elements of long half life (coming from the radioactive fallout of test explosions) predominate. (auth)

10322 ON THE RADIOACTIVITY OF CERTAIN BUILDING MATERIALS. (Moscow Medical Inst.). Z. P. Barlyaeva, A. A. Velichko, and N. G. Prokofeva. Gigiena i Sanit., No. 8, 94-5(Aug. 1963). (In Russian)

End-window and cylindrical counters were used for determining the α- and β activity of 16 construction materials. Tabulated data show that materials with relatively high α activity usually exhibited high β activity. Granite and brick materials showed higher radioactivity than wood and concrete. In concrete the activity depended greatly on the fillers used in mixing. (R.V.J.)

10323 COSMIC RADIATION DOSES ABSORBED BY A. G. NIKOLAEV AND P. R. POPOVICH DURING GROUP ORBITAL FLIGHT. I. B. Keirim-Markus, N. A. Sergeeva, and L. N. Uspenskii. Kosmich. Issled., 1: 179-81(July-Aug. 1963). (In Russian)

Measurements of cosmic radiation tissue doses during group flight showed 16 mr/day, considerably larger than that experienced by Titov, however the bremsstrahlung dose was considerably smaller. The maximum of neutron flux in the space vehicle was estimated. (R.V.J.)

10324 TOLERANCE TIME FOR WORK IN THE HEAT WHEN WEARING CBR PROTECTIVE CLOTHING. Ralph F. Goldman (Army Research Inst. of Environmental Medicine, Natick, Mass.). Military Med., 128: 776-86(Aug. 1963).

A study was undertaken to assess the work capabilities of a soldier wearing partially or totally vapor-impermeable clothing. The standard CBR protective and a new integrated CBR protective suit were evaluated under controlled climatic chamber conditions. The results suggest that, when wearing either of these uniforms (no gross differences were noted between them), soldiers should be heat-acclimatized and physically conditioned if they are to be required to do moderately heavy work for 1 hr, even in a temperate ambient environment. The data also indicated that to test the clothing out-of-doors where solar radiation must be considered, the temperature should be within a range of from 70° to 90°F and the relative humidity between 30 and 75%. Accordingly, a field trial of the standard CBR protective ensemble, the hot-weather protective ensemble, and the standard (nonprotective) utility uniform was conducted at Fort Lee, Virginia. The results of the field test confirmed the chamber findings as to the advisability of heat-acclimatizing individuals wearing protective clothing, and further defined the limitation that is imposed by the current CBR-protective uniforms. (BBB)

10325 PREPAREDNESS AT THE COMMUNITY LEVEL—AN URGENT GOAL. Luther L. Terry (Public Health Service, Washington, D. C.). N. Y. State J. Med., 63: 1972-6(July 1, 1963).

Development of plans at the local level to ensure survival of maximum numbers of the population following a thermonuclear attack is discussed. Seven elements, considered necessary to prepare the community for any emergency, are outlined. These include medical self-help training of the population, effective utilization of available medical and allied health personnel, expanded and coordinated operation of all available hospitals and other health facilities, prudent use of medical supplies and equipment, adequate supply of safe water for emergency use, provision for the rehabilitation of damaged health facilities, and restoration and maintenance of the health of the surviving population. It is proposed that emergency preparedness plans should utilize and build on existing health organizations, services, and professional personnel. Intensification of the usual programs should constitute a first line of health defense in any emergency, and a sense of readiness and a core of skills should be developed that are indispensable in a disaster situation. The medical profession bears a heavy responsibility in community programs of health preparedness; in times of disaster, physicians will give leadership to all health operations. They should also guide the development of disaster preparedness plans by setting forth priority needs for health skills, by outlining the special training that is required, and by determining the manner in which health personnel can be best organized in an emergency to assure the most efficient operations. In this way, the community can be sure that all health personnel will know their assignments, and will be equipped to carry them out under any circumstances. Emergency health training can also be put to good use against the hurricanes, floods, tornadoes, and other misfortunes which disrupt entire communities and cause untold misery. It is suggested that every disaster, or every threat of disaster, should be used as a training ground for civil defense operations. The capability of handling a hypothetical attack should provide a means of responding effectively to natural disasters. Civil defense, it is suggested, is a cooperative undertaking, an interlocking job calling for greatest application of ingenuity, perseverance, and leadership. It involves all members of the health professions and all levels of government, but begins with the local community. (BBB)

10326 PINPOINTING THE PHYSICIAN'S RESPONSIBILITY IN CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL DEFENSE. Alan W. Donaldson (Public Health Service, Atlanta). N. Y. State J. Med., 63: 2129-31(July 15, 1963).

The civil defense implications of CBR warfare are discussed. It is concluded that CW, BW, and RW (referring here to ionizing radiations resulting from fallout rather than that associated with the initial blast) have certain general characteristics in common. They can produce large numbers of casualties over fairly extensive areas; they cause death or disability by alteration or interference with normal physiologic processes; in most cases, the agents can be present at sufficient levels to cause their effects without being detectable by the senses; and in the case of CW and BW agents brief exposure to minimal quantities may be sufficient to result in death or disability. In the event of attack with any one of these weapons, it is almost inevitable that civilian populations as well as military personnel would be affected. On the basis of these general characteristics alone, to which are added the specific effects of chemical toxins, pathogenic organisms, and ionizing radiation, the total medical and public health problems which could result from individual or combined use of these three weapons systems appears almost overwhelming. Responsibilities of the physician in the pre-attack period to improve defenses against CW, BW, and RW are considered. (BBB)

10327 THE STUDY OF THE STRIPPING VARNISHES USED TO PROTECT A SURFACE AGAINST RADIOACTIVE CONTAMINATION. Aleksander Siemaszko, Juliusz Siejka, Marian Nowak, and Jozef Stolarz (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 8: 264-8(1963). (In Polish)

Three types of stripping varnishes were used in conjunction with the radioisotopes Cs^{137} and Ce^{144} in the study of radioactive contamination of several types of surfaces. The radioisotopes were in the form of water solutions, as chlorides, in a concentration of 15 μC/ml. The characteristics of the varnishes studied were the penetration of the radioactive water solution through each varnish, the surface contamination of each type of surface, and the stripping ability of each varnish. The varnishes were found to be useful for surfaces of metals, wood, glass, ceramics, etc., but not on surfaces, such as plexiglas, that interact with the lacquer and make stripping unfeasible. In such cases, a primer coat is recommended. (TTT)

10328 LABORATORY GLOVEBOXES TO WORK WITH RADIOACTIVE AEROSOLS. Aleksander Siemaszko, Marian Nowak, Roman Broszkiewicz, and Juliusz Siejka (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 8: 268-71(1963). (In Polish)

Both a dusting box and a liquid-spray box are described. Both are constructed of plexiglas reinforced and sealed with aluminum angle. The dusting box consists of a box within a box for added safety and to provide an intermediate chamber for measuring the degree of radioactive deposit. The liquid spray box is a single walled box equipped with an aerosol gun. Both types of chambers have air-circulation and filter systems. Remote handling mechanisms are also included. (TTT)

10329 RADIOLOGICAL HEALTH DATA [MONTHLY REPORT], VOLUME IV. NUMBER 12. (Public Health Service, Washington, D. C.). Dec. 1963. 45p. $0.50 (GPO). RHD-Vol.IV, No. 12.

Data are presented on fission product radioactivity in airborne particulates, precipitation, and surface waters sampled during 1963 throughout the U. S., Canada, Pan American countries, and along the 80th meridian. Milk samples collected throughout the U. S. and Canada during 1963 were analyzed for Sr^{89}, Sr^{90}, I^{131}, Cs^{137}, and Ba^{140} Estimates are presented of the Sr^{90} content of the average diet of individuals living in New York City, San Francisco, and Chicago from February through April 1963. Three low-yield underground nuclear detonations at the Nevada Test Site were reported during Nov. 1963. Separate abstracts were prepared on 3 sections of this report. (C.H.)

For abstracts of individual papers see: 10330, 10331, and 10332.

10330 CALIFORNIA MILK NETWORK AND MILKSHED COMPARISONS, APRIL–JUNE 1963. John M. Heslep and Amasa C. Cornish. Radiol. Health Data, 4: 596-599 (Dec. 1963).

Data are presented on the content of Sr^{89}, Sr^{90}, I^{131}, Cs^{137}, and Ba^{140} in samples of milk from California milksheds during April, May, and June, 1963. (C.H.)

10331 RADIONUCLIDES IN INSTITUTIONAL DIET SAMPLES, APRIL–JUNE 1963. Radiol. Health Data, 4: 605-10(Dec. 1963).

Data are presented on the content of Sr^{89}, Sr^{90}, Cs^{137}, I^{131}, and Ba^{140} in diet samples collected from April through

June 1963 from 21 boarding schools or institutions geographically distributed throughout the U. S. Data are included on institutional daily dietary intake for children in various age groups. (C.H.)

10332 STRONTIUM-90 AND CESIUM-137 CONTENT OF BEEF AND BEEF PRODUCTS, 1960–1962. Radiol. Health Data, 4: 612-13(Dec. 1963).

Data are presented on the Sr^{90} and Cs^{137} content of beef and beef products sampled throughout the U.S. from 1960 through 1962. (C.H.)

10333 IODINE-131 THYROID DOSE FROM MILK IN ITALY DURING THE PERIOD SEPTEMBER 1962 TO FEBRUARY 1963. Arrigo A. Cigna and Franco G. Giorcelli (Comitato Nazionale per l'Energia Nucleare, Rome). Science, 143: 379-80(Jan. 24, 1964).

During the period September 1962 to February 1963, I^{131} was measured in milk sampled in 14 Italian cities. At the end of the period the average intake was 9100 pC, corresponding to a thyroid dose of 0.31 rad; the maximum intake (at Bari) was 16,300 pC, corresponding to a thyroid dose of 0.56 rad. (auth)

10334 RADIATION HAZARDS AND PROTECTION. D. E. Barnes and Denis Taylor. New York, Pitman Publishing Corporation, 1963. 229p. $8.50.

A comprehensive survey on radiation hazards and protection is presented. Topics discussed in detail include the nature and properties of radiation, effects of radiation on man, permissible radiation doses, radiation detection instruments, shielding, criticality, health physics practices, waste disposal, and the transport of radioactive materials. Radiation from nuclear weapons and the hazards due to intense microwave radiations are also discussed. A complete subject index is included. (C.H.)

INSTRUMENTATION

General

Refer also to abstract 10580.

10335 (EUR-430.i) SENSIBILITA E RITARDO NEI CIRCUITI A SCATTO. (Sensitivity and Switching Delay in Trigger Circuits). I. De Lotto and L. Stanchi (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1963. 44p.

The problem of regeneration in trigger circuits is studied, particularly in relation to switching delay and switching time. The factors that affect the speed, such as the threshold as a function of the input signal duration, are examined. The sensitivity of the circuit is also discussed. The characteristics of the dipole equivalent to a trigger circuit are determined, and the switching delay and switching rise time are examined using considerable simplifications (circuits with constant parameters) and graphical methods. For the particular case of a transistor circuit, the equation of the equivalent circuit is derived taking into account the nonlinearity of the parameters. This equation is processed by means of an analog computer. Using experimental data, the circuits are classified according to their sensitivity and the switching delay. A merit figure is obtained for synthetically evaluating different circuits and optimizing circuit sensitivity and speed. (auth)

10336 (HW-79127) TESTING REACTOR INSTRUMENTATION WITH EXPONENTIAL SIGNALS. B. E. Dozer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1963. Contract AT(45-1)-1350. 20p.

Some considerations in determining the response of reactor instrumentation to exponentially increasing signals are indicated. Several methods of testing these instruments as well as factors leading to poor response are given. A rising exponential generator was developed for use in some of these tests. Certain precautions necessary in its use are pointed out. (auth)

10337 (K-1593) AN INEXPENSIVE AUTOMATIC RECORDING BALANCE. J. Farquharson (Oak Ridge Gaseous Diffusion Plant, Tenn.). Feb. 3, 1964. Contract W-7405-eng-26. 13p.

A method is described for inexpensively converting a commercial beam-type chain weight analytical balance for automatic recording operation. In this null-type instrument, beam unbalance is detected by a photoelectric device. The restoring force is obtained by the action of a simple electronic servo system on the chain weight. Readout may be graphic or digital or both. The range, without manual manipulation of weights, is 100 milligrams. (auth)

10338 (LNF-63/54(p.15-17)) SEMPLICE STAZIONE D'ASCOLTO PER SATELLITI ARTIFICIALI. (Simple Listening Post for Artificial Satellites). G. Boella, G. Delgi Antoni (Milan. Universita. Istituto di Scienza Fisica and Italy. Istituto Nazionale di Fisica Nucleare, Milan); and G. Quaranta (Milan. Università. Istituto di Scienza Fisica).

The essential characteristics of a N.R.L. solar radiation satellite are briefly reviewed as an introduction to a description of the outfitting of a listening post for such satellites. The telemetry signals are received on Monte Mariano in Parma and transmitted to the University of Milan. Other uses of the station are indicated. (J.S.R.)

10339 (LNF-63/54(32-3)) MISURATORE TRANSISTORIZZATO DI CORRENTI FINO A $10^{-14} \sim 10^{-15}$ A. (Transistorized Ammeter Sensitive Up to $10^{-14} \sim 10^{-15}$ amp). F. Lepri.

A transistorized ammeter for use in satellites that measures currents from 10^{-11} to $10^{-14} \sim 10^{-15}$ amp is described. Its consumption is <10 mw, weight <100 g, volume <500 cm^3, and measurement time ~10 sec. The circuit and its characteristics are given. (J.S.R.)

10340 (NP-13511) AMPLIFICADOR DE CORRIENTE CONTINUA. Informe No. 92. (Direct Current Amplifier. Report No. 92). Carlos Marazzi (Argentina. Comisión Nacional de Energía Atómica, Buenos Aires). 1963. 11p.

A direct-current amplifier with low zero current and solid-state chopper for input is described. This amplifier can be used in control circuits and for general applications such as temperature measurement in thermocouples, amplifier for a photo-sensitive element, or zero amplifier in control systems. The input impedance is relatively low, serving principally as current amplifier. It is possible to obtain a symmetry characteristic for positive and negative values of the output voltage with respect to the input. (tr-auth)

10341 (NP-13571(p.24-5)) PRECISION MANOMETERS FOR ACCURATE LEVELING OF SOZOTRON LENSES. H. R. D. Roess and D. C. dePackh (Naval Research Lab., Washington, D. C.).

A level consisting of two mercury manometers connected by a plastic hose was used in positioning the beam focusing lenses. Using micrometer-mounted contacts at each manometer, the mercury level was determined within 0.001 in. The design, performance, and procedures are briefly discussed. (D.C.W.)

10342 (RADC-TDR-63-54) A STUDY OF PLASMA APPLICATIONS IN MICROWAVE CIRCUITS. Final Report. A. Olte and E. K. Miller (Michigan. Univ., Ann Arbor. Radiation Lab.). Jan. 1963. Contract AF30(602)-2605. 95p. (ORA-4915-1-F; AD-409596)

The use of plasmas in microwave applications was investigated. It was reconfirmed that components such as the coaxial variable attenuator and switch using plasmas may be potentially feasible. It appears that local ionization of the gas must be used to control the microwaves. It is not very easy to achieve linear attenuation with this mechanism. Not much success was achieved with diffusion of plasmas by application of voltage gradients. A microwave isolator employing a magneto-plasma was investigated experimentally. A very significant isolation was obtained by the non-reciprocal mode conversion. As a result the principal mode-cyclotron resonance absorption which was observed was less than anticipated. The sensitive dependence of the non-reciprocal mode conversion on the discharge current may offer a mechanism for designing a microwave limiter. (auth)

10343 (SIT-P78) TECHNICAL SPECIFICATIONS OF AN EXPLODING-WIRE-TRIGGERED SOLID DIELECTRIC SWITCH. Henry Huber (Stevens Inst. of Tech., Hoboken, N. J.). Jan. 1963. Contracts AT(30-1)-2813 and DA-36-039-SC-87242. 13p.

An exploding-wire-triggered solid dielectric switch with less than 2×10^{-9} henry and 5×10^{-3} Ω total inductance and resistance is described. Crowbar and series operation are

possible with the same switch. Currents up to 250 kiloamps and energies up to 2 kilojoules have been switched. (auth)

10344 (TID-20007) DEVELOPMENT LEADING TO AN IMPROVED DENSITOMETER FOR HELIUM–GRAPHITE OR NITROGEN–GRAPHITE FLOW STREAMS. Final Report No. 189. Donald H. Strobel (Badger Meter Mfg. Co., Milwaukee). Dec. 31, 1963. Contract AT(11-1)-1111. 67p.

A densitometer capable of measuring the density of finely divided graphite particles in a carbon dioxide, helium, or nitrogen gas flow stream at test loop operating pressures and temperatures is described. The instrument is a null-balance type of servomechanism using low energy radioisotopes as the sensing transducers to eliminate direct contact with the flow stream. Tests indicate that the meter will measure the flow stream densities with a maximum range of 0.1544 g/cm^3 at an accuracy of 0.23% of full scale. Readability of output is better than 0.1% of full scale. Calibration of the meter is stable indefinitely since it is dependent only on the mechanical integrity of the calibrated wedge. (N.W.R.)

10345 (TID-20126) SODIUM RESISTIVITY METER LOOP. Summary Report, December 1963. (Atomic Power Development Associates, Inc., Detroit). Contract AT(11-1)-865. 9p.

A series of experiments for the evaluation and improvement of several in-line meters designed to determine the contamination level of various impurities in a controlled sodium loop were completed. The performance and contamination of the loop cold trap, line sections, rhometer, and variable-orifice plugging meter were evaluated. Recalibration of the rhometer and plugging meter for sodium hydride contamination by hydrogen gas injection procedures was made. (N.W.R.)

10346 (X64-11113) DEVELOPMENT OF ELECTRICAL SWITCHGEAR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS. Quarterly Progress Report No. 1, July 16, 1963–October 16, 1963. R. N. Edwards, ed. (General Electric Co. Spacecraft Dept., Cincinnati). Contract NAS 3-2546. 87p.

The design, development, fabrication, and testing of three types of switchgear for application in space nuclear electric systems are being studied. The a-c circuit breaker and d-c engine contactor will have a vacuum interrupter, and the d-c circuit breaker will have a high-pressure gas interrupter. A radiation effects study has identified no major problems associated with vacuum interruption in the specified radiation environment. Consideration of temperature effects dictates exploratory and confirmatory tests on contact welding, current interruption capability, and chopping characteristics at the elevated temperatures involved. Selection of useable and compatible materials and preliminary conceptual design approaches are initiated. A test program is outlined and facilities preparation is started. (N.W.R.)

10347 (JPRS-22697(p.146-62)) INSTALLATION FOR THE X-RAY STRUCTURAL ANALYSIS OF RADIOACTIVE MATERIALS. Yu. I. Gribanov, A. G. Karmilov, and I. A. Lednev. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263(p.146-62))

The problem of separating the useful and interfering radiations in x-ray studies of radioactive materials is discussed. Currently known diffractometers are considered. A diffractometer installation was designed in which the x-ray intensity is modulated, and the signals are distinguished by means of a narrow-band selective amplifier. The principles and operation of the installation are described in detail. X-ray patterns are presented of Al (which show this installation to be advantageous for inactive as well as active specimens), of unirradiated and irradiated UM-9 U–Mo alloy (the appearance of α-phase in the γ-phase is noted), and of irradiated stainless steel. (D.L.C.)

10348 (UCRL-Trans-1022(L)) CALORIMETRIC APPARATUS FOR MEASURING THERMAL PROCESSES OVER LONG TIME PERIODS. M. I. Voskoboinikov, A. P. Kubantsev, and V. A. Prokhorov. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore), from Zh. Fiz. Khim., 32: 460-4(1958). 11p.

A differential calorimeter and its electronic diagram are described. A thermostat permits measurements to be made at temperatures 25 to 150°C, maintaining a given temperature for lengthy periods of time with a precision of 0.1°C. Measurements were made on this arrangement of the heat evolution of the radioactive isotopes P^{32} and Sb^{122}. The error in the determination of the overall value of heat evolution is 0.05%. (auth)

10349 AUTOMATIC LENS DESIGN FOR NONEXPERTS. Berlyn Brixner (Los Alamos Scientific Lab., N. Mex.). Appl. Opt., 2: 1281-6(Dec. 1963). (LADC-5864)

Automatic lens design by nonexperts is practical with the 1962 LASL lens-designing code, a general-purpose iterative program for evaluating and designing optical lens and mirror systems with surfaces generated by conic sections. Using skew ray traces, it analyzes lens performance statistically, finds differences resulting from design-parameter alterations, and computes a linear combination that will improve performance. Program characteristics, lens parameters, ray sampling, image evaluation, lens-performance weights, merit calculation, and parameter interactions are briefly described. Sample calculations are given in detail for a Lister-type lens and for a special-purpose zoom lens. (auth)

10350 SPUTTERING ION SOURCE FOR SOLIDS. Helmut J. Liebl and Richard F. K. Herzog (Geophysics Corp. of America, Bedford, Mass.). J. Appl. Phys., 34: 2893-6(Sept. 1963).

A new ion source for the analysis of solids was constructed. The ions are sputtered from the surface of the sample target by bombarding it with a concentrated beam of argon ions. The bombarding beam has an energy of 10 to 12 kv and an intensity of about 1 mamp. This large intensity produces a secondary beam of target ions of about 10^{-6} amp which is quite adequate for a routine analysis. In contrast to a spark source, the sputtering source gives very stable operation and allows electrometric recording of the mass spectrum. The mass spectra obtained are very simple and consist of peaks representing singly charged species. The source is not limited to metals or semiconductors, since good mass spectra were obtained from insulators. (auth)

10351 MEASUREMENT OF THE LINE SPREAD-FUNCTION OF RADIOGRAPHIC SYSTEMS CONTAINING FLUORESCENT SCREENS. K. Rossmann, G. Lubberts, and H. M. Cleare (Eastman Kodak Co., Rochester, N. Y.). J. Opt. Soc. Am., 54: 187-90(Feb. 1964).

A method was devised for measuring the line spread-function of medical radiographic systems by means of a 10-μ slit with uranium jaws. It is shown theoretically that the inherent error introduced by the finite width of the slit is negligible because the screen–film systems are of poor optical quality. Line spread-functions of two typical systems were measured. From one of these, the intensity distribu-

tion in the image of a uranium edge was calculated and found to agree with the measured distribution. (auth)

10352 TRANSISTORIZATION OF A SAFETY AMPLIFIER FOR NUCLEAR REACTORS. Hideyuki Yashima and Katsuhiko Kawashima (Mitsubishi Electric Corp., Japan). Mitsubishi Denki Giho, 37: 1161-5(Sept. 1963). (In Japanese)

Transistorizing the electronic circuits used for nuclear instrumentation is desirable in order to help reduce the size of equipment increase reliability, and facilitate maintenance. However, the principle of "fail safe" predominates everything in the design. In transistorizing the safety amplifier, the heart of the nuclear apparatus, a new idea of a-c operation was developed successfully for the solution of the problems. This safety amplifier has a highly improved performance involving a high degree of "fail safe" characteristics, short scram response time, and lasting stability. (auth)

10353 THE STABILIZATION OF COEFFICIENT OF AMPLIFICATION FOR EMI 6097-F AND FEU-29. Edward Chrusciel and Stanislaw Kwiecinski. Nukleonika, 8: 273-6(1963). (In Polish)

A gain stabilization arrangement is described wherein the voltage U_b between the Nth and (N + 1)th dynode of a photomultiplier tube is held fixed with a floating battery supply. A voltage-dropping resistance R_a, placed in the bleeder string between the Nth and (N + 2)th dynode, is then properly adjusted. The value of R_a is chosen such that, with the total photomultiplier voltage U_f and the voltage U_b held constant, the gain versus resistance has negative slope and the gain is equal to half its maximum value. The value of R_a must in this way be individually adjusted for each type of photomultiplier tube and also for each individual tube of a given type. Curves are given for pulse-amplitude versus U_f for EMI 6097-F and FEU-29 photomultiplier tubes. (TTT)

10354 LOW LEVEL AMPLITUDE DISCRIMINATOR. Andrzej Zastawny (Technical Univ., Danzig). Nukleonika, 8: 345-54(1963). (In Polish)

A basic low-level discriminator is described in which a diode is connected to the plate circuit of the first amplifier tube of a Schmidt-type discriminator circuit. The circuit equations are discussed for this basic type of circuit. Three variations on this type of circuit were studied and the linearity of each variant is given. The optimum choice of passive circuit elements that yields the most favorable linearity curve is given for each variant. Two different types of amplifier tubes were evaluated. The best circuit yielded very good linearity in the range of 2 to 160 mv pulse height of the input signal. The maximum count rate for this circuit does not exceed 10,000 per second. The raising of this count-rate limit is the subject of further investigation. (TTT)

10355 HIGH POWER RF PULSE GENERATOR. Erich S. Weibel (Laboratoire de Recherches sur la Physique des Plasmas, Lausanne, Switzerland). Rev. Sci. Instr., 35: 173-5(Feb. 1964).

A circuit is described that is capable of delivering radio frequency pulses at very high power levels. In a first test 10 Mw of power at 2 Mc were delivered to a 4-Ω load. The pulse duration was only 3 periods, but it could be increased by a factor of 30 or more. The power level could be increased by a factor of 5 to 10. (auth)

10356 SIMPLE ANEROID CALORIMETER WITH REPLACEABLE REACTION CELLS. Stuart R. Gunn (Univ. of California, Livermore). Rev. Sci. Instr., 35: 183-7 (Feb. 1964). (UCRL-7464)

An isothermally jacketed copper block calorimeter with removable glass reaction cells used for measurement of heats of gaseous reactions from 25 to 150°C is described. Design considerations are discussed. Thermistor thermometry was employed at 150°; normalization of the data is treated. (auth)

10357 DOUBLE-FOCUSING COUNTER-TUBE MASS SPECTROMETER. Fritz Kirchner and Alfred Benninghoven (Universität, Cologne). Z. Angew. Phys., 16: 290-2(Nov. 1963). (In German)

Investigations on the applicability of double-focusing counter-tube mass spectrometers with iodine vapor counters for determination of mass spectra and trace analysis are reported. An ionizing electron current of several 10^{-10} amp is generally sufficient for taking normal mass spectra with counter tube and recorder. The effect of the iodine vapor can be kept so low through simple cut-in of a condenser cooled with liquid air that the 127 mass of the iodine atom is scarcely noticeable. In the determination of the minimum gas mass that could be detected and quantitatively measured, it was surprisingly proved that in the use of He as the test gas in the unheated mass spectrometer at a gas pressure of 5×10^{-6} Torr of the residual gas, there is a perturbation maximum at mass 4. This could significantly affect the sensitivity of helium detection. (tr-auth)

10358 SHIELDING REQUIREMENTS FOR ELECTRONIC COMPONENTS IN RADIATION ENVIRONMENTS. A. J. Beck and E. L. Divita (Martin Co., Baltimore). 15p. (CONF-284-3)

From National Electronics Conference on Adaptive Processes, Chicago, Oct. 1963.

Data on the natural and artificial radiation environments were surveyed and realistic radiation environmental models were selected for use with radiation shielding analyses programmed for the digital computer. These programs evaluate the radiation levels in shielded compartments resulting from primary protons, primary electrons, and secondary radiations produced in the protective shielding such as neutrons, gamma rays, and bremsstrahlung. Radiation levels computed by means of these programs are presented for flights in the natural and artificial radiation belts and for missions exposed to typical solar flare events and galactic cosmic radiation. The unshielded and shielded radiation fluxes incident on solar cells are evaluated for orbital flight in the artificial radiation belt and solar flare radiation. An estimate of the degradation of output power is determined as a function of time in the assumed radiation environment. (auth)

10359 PULSED MOLECULAR BEAM PRODUCTION WITH NOZZLES. Otto-Friedrich Hagena (Kernforschungszentrum, Karlsruhe, Ger.). 21p. (CONF-290-4)

From Conference on Molecular and Atomic Gas Beams, Charlottesville, Va., May 1963.

Molecular beam experiments that can be carried out in pulsed operation may be performed at considerably reduced expense for apparatus if, for pulse generation, the gas supply to the beam production system is interrupted as opposed to the usual steady molecular beam. This technique is studied by measuring intensity vs time of molecular beam impulses of varying length, how fast and through which intermediate states the initial intensity of the impulse attains equilibrium, and in which way the intensity of the molecular-beam impulse is affected by the pulse length and by increasing pressure in the first pressure stage. For production of pulses, a magnetically actuated, quick shutting, valve is used whose scaling area is

the inlet cone of the nozzle used for the beam generation. The shortest pulses produced had a pulse length of 1.6 ms. (auth)

10360 CYCLOTRON WAVE HARMONIC GENERATOR. Eric A. Ash (to International Standard Electric Corp.). U. S. Patent 3,118,083. Jan. 14, 1964. Priority date Aug. 30, 1960, Great Britain.

An electron beam harmonic wave generator is described comprising a hollow waveguide, means for projecting an electron beam in the waveguide and for exciting fast mode backward wave oscillations at cyclotron frequency, and a cavity resonator tuned to a harmonic of the cyclotron frequency and supporting a mode having the same azimuthal field distribution as the electron beam current. Electrodes are provided for electron beam projection. (R.E.U.)

10361 VERNIER CHRONOTRON UTILIZING AT LEAST TWO SHORTED DELAY LINES. Richard P. Rufer (to U. S. Atomic Energy Commission). U. S. Patent 3,122,648. Feb. 25, 1964.

An improved vernier chronotron featuring pulse-forming circuits of a "ringing" or "back and forth" oscillatory type is described. A delay line shorted at both ends together with transistor circuitry to introduce a pulse into that line and also to provide reinforcement of the pulse as it oscillates between the pulse-reflective extremities is provided. A transistorized coincidence circuit is also provided. Enhanced measurement of time intervals in the nanosecond range is afforded. (AEC)

Radiation Detection

Refer also to abstract 10308.

10362 (AD-404030) THERMOLUMINESCENT DOSIMETER COMPUTER-INDICATOR SYSTEM. PHASE II. Final Engineering Report, June 15, 1962 to October 15, 1962. (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). Oct. 15, 1962. Contract NObsr-85506. 66p.

Final design criteria were established for the thermoluminescent dosimeter computer-indicator. Techniques for the production of the CaF2: Mn phosphor, application of the phosphor to the dosimeter heater substrate, and electronic and mechanical design for the computer-indicator are described. Performance of the system and its reliability and accuracy are presented. (auth)

10363 (AD-404888) DEVELOPMENT OF DOSIMETER CALIBRATION ATTACHMENT FOR CDV-794X. Final Type Report (Technical). A. M. Filipov (Tracerlab, Inc., Waltham, Mass.). Jan. 1963. Contract OCD-OS-62-260. 39p.

The requirements of the dosimeter calibrator are presented, and specific solutions to the design are given. The necessary modifications to the CDV-794X calibrator, and a method to prepare existing calibrators for use with the attachment are described. The specifications for the attachment are tabulated, and the test specifications and procedures are given. Test data obtained from a series of repeated readings with the dosimeters provided show the accuracy attainable in checking a dosimeter for proper operation. (auth)

10364 (AEEW-R-306) DESIGN CRITERIA FOR PULSE TRANSFORMERS USED IN NEUTRON DETECTOR PULSE COUNTING CHANNELS. E. P. Fowler (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1963. 51p.

The matching of a neutron detector to a pulse counting channel by means of transformers at one or both ends of the connecting cable is examined. System optimization and prediction of performance in terms of signal-to-noise ratio are treated. Related problems including the use of balanced twin cables, the requirements of temperatures up to 500°C, and the need for high interference rejection are also considered. A system that performs satisfactorily using a 100 ft cable and with the detector at 550°C is described. (auth)

10365 (AERE-R-4397) THE MEASUREMENT OF BETA DOSE AND THE CALIBRATION OF SOME BETA-GAMMA SURVEY INSTRUMENTS. H. J. Gale and L. H. J. Peaple (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1963. 17p.

An extrapolation ionization chamber was constructed and used to measure the dose rate from sources of the pure beta emitters Tl^{204}, P^{32} and Y^{90} at a number of distances in air. The sources were then used to determine the response per unit dose rate for four survey instruments, which although primarily intended for gamma ray measurement have facilities for indicating beta dose rate. Calibration curves are given that will enable interpretation of the readings in a number of conditions. The commonly used Type 1349A has serious limitations, but satisfactory results may be obtained with the hot spot monitor Type 1657A and the beta sensitive quartz fibre electroscope Type 1376A. When great sensitivity is required the Type 1320A G.M. probe can be used, provided the beta energy is known. The variation of dose rate with distance from the sources used is in good agreement with that of other observers. (auth)

10366 (ANL-6797(p.111-32)) RISØ CURVED-CRYSTAL SPECTROMETER. O. W. B. Schult, B. P. Maier, U. Gruber, and R. Koch (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø and Munich. Technische Hochschule).

The requirements and design of a curved-crystal spectrometer for neutron-capture gamma ray measurements at the DR-3 reactor at Risø, Denmark, are discussed. Data are given for levels in Dy^{164} and Lu^{177} populated after neutron capture. (R.E.U.)

10367 (ANL-6797(p.156-78)) RECENT DEVELOPMENTS IN PRECISION DIFFRACTION MEASUREMENTS RELATED TO NEUTRON-CAPTURE γ-RAY SPECTRA. J. W. Knowles (Atomic Energy of Canada Ltd. Chalk River Nuclear Labs., Chalk River, Ont.).

Improvements in precision neutron-capture gamma-ray measurements using double-flat-crystal diffraction spectrometers are discussed. (R.E.U.)

10368 (ANL-6797(p.438-40)) INSTRUMENTATION FOR FISSION-FRAGMENT ENERGY CORRELATION EXPERIMENTS WITH PILE-UP REDUCTION CAPABILITIES. C. W. Williams, H. W. Schmitt, F. J. Walter, and J. H. Neiler (Oak Ridge National Lab., Tenn.).

The measurement of kinetic energies of correlated fragment pairs from thermal- and resonance-neutron-induced fission is reported. A three-parameter ternary-fission experiment is also discussed. A method of detecting pile-up pulses in detection systems is described. (R.E.U.)

10369 (BNL-7675) EARLY TESTS ON THE BNL MARK-II HPD. [R. B. Palmer] (Brookhaven National Lab., Upton, N. Y.). July 15, 1963. Contract [AT(30-2)-Gen-16]. 12p.

An account is given of some of the experiences with the BNL Mark II HPD, a flying spot film measuring machine

employing crossed glass fibers. The motor, bearings, moving fibers, fixed fibers, optics, and spot size are discussed. (D.L.C.)

10370 (BNL-7681) TRACK CENTER CIRCUIT FOR BNL HPD MARK I. Jan van der Lans (Brookhaven National Lab., Upton, N. Y.). Oct. 3, 1963. Contract AT (30-2)-Gen-16. 11p.

A bubble on the film is converted by the flying spot and a photomultiplier into an electrical pulse, and the pulse center is then determined by a track center circuit (TCC). The original TCC developed by P. V. C. Hough and its disadvantages are described. The TCC now in use on the BNL Mark I HPD has none of the above disadvantages, i.e., no meaningless track center pulses are created. The circuit and its performance are described in some detail. (D.L.C.)

10371 (CERN-64-4) LARGE-AREA PLASTIC SCINTILLATION COUNTER. E. Alleyn, H. Faissner, H. J. Gerber, E. Heer, and M. Reinharz (European Organization for Nuclear Research, Geneva). Jan. 14, 1964. 15p.

The construction and performance of a large-area plastic scintillation counter ($50 \times 80 \times 2$ cm^3) of especially simple design are described. Pulse-height spectra were measured with a beam of minimum ionizing particles hitting different points of the counter. The results are compared with theory. The percentage of light collection and the pulse height are calculated absolutely. The influence of magnetic fields on the performance was determined experimentally. A hundred of these counters are used in the CERN neutrino experiment to give the triggering signal for the spark chambers. (auth)

10372 (CONF-187-55) ENERGY DEPOSITION BY FAST NEUTRONS. II. YIELD OF THE FRICKE DOSIMETER AT 14.6 Mev. Robert C. Axtmann and Joseph A. Licari (Princeton Univ., N. J.). [1963]. Contract AT(30-1)-2807. 21p.

From American Nuclear Society Meeting, New York, Nov. 1963.

A measurement of the yield of the aerated, ferrous sulfate-sulfuric acid (Fricke) dosimeter for 14.6-Mev neutrons gave a value of $G_{Fe^{+3}} = 11.5 \pm 1.8$. $G_{Fe^{+3}}$ is the number of ferric ions produced per 100 ev deposited. The determination combined an analysis of the energy deposited by scattering and charged particle reactions with a determination of the neutron flux by two independent means: a "long counter" method and an activation technique. The result is in reasonable agreement with a prediction for $G_{Fe^{+3}}$ based on measured yields of the dosimeter to irradiations by monoenergetic charged particles. (auth)

10373 (CONF-187-57) MEAN SQUARE VOLTAGE FLUCTUATION MEASUREMENTS WITH NEUTRON-SENSITIVE ION CHAMBERS. R. A. DuBridge (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Nov. 1963. Contract AT(04-3)-189. 12p.

From American Nuclear Society Meeting, New York, Nov. 1963.

The mean square fluctuation voltage in neutron sensitive ion chambers was measured rather than the d-c current to improve gamma discrimination and eliminate d-c cable leakage interference currents. The circuitry and chamber are described, and performance in the mean square voltage mode is compared with that in the d-c current mode. (D.C.W.)

10374 (D2-9878-4) DEFINITION OF TRANSIENT RADIATION SIMULATION ENVIRONMENT. A. R. Lowrey, R. K. Durkee, and Carl Rosenberg (Boeing Co. [Aero-Space Div.,] Seattle). Apr. 30, 1962. 189p.

The interpretation of transient radiation effects on electric components due to pulses of x or gamma rays and neutrons requires the accurate determination of the pulsed radiation. A description is given of the dosimetry techniques and analysis used to determine the gamma and neutron radiation simulation environments in the Kukla pulsed reactor and flash x-ray facilities. Results are given of measurements of the general radiation characteristics of the Kukla and flash x-ray facilities. (D.L.C.)

10375 (FFIF-TN-F-61) ELECTROSTATIC RELAY FOR USE IN CONNECTION WITH RADIATION MONITORING. K. Sand (Norway. Forsvarets Forskningsinstitutt, Kjeller). Dec. 14, 1962. 37p. (AD-403764)

Construction data and specifications are given for a sensitive electrostatic relay developed for use in connection with radiation monitoring. (auth)

10376 (HW-79054(p.82-9)) DEVELOPMENT OF A SPECTROMETER FOR SLOW-NEUTRON INELASTIC SCATTERING BY TIME-OF-FLIGHT. O. K. Harling (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A rotating-crystal spectrometer to be used in measuring the double-differential scattering cross sections for initially monoenergetic neutrons is described. Energy analysis of neutrons in the incident beam will be by Bragg reflection off a rapidly-rotating single crystal. The scattered neutrons will be analyzed by time-of-flight. A mechanical chopper operating in phase with the rotating crystal will eliminate undesired crystal reflections. (D.C.W.)

10377 (IKF-10) ANALYSE KOMPLEXER IMPULSHÖHENSPEKTREN DISKRETER GAMMA-STRAHLUNG MIT HILFE EINER ELEKTRONISCHEN RECHENANLAGE. (Computer Analysis of Complex Pulse-Height-Distributions from Scintillation Gamma-Ray Detectors). P. Mueller (Johann-Wolfgang-Goethe-Universität, Frankfurt am Main. Institut für Kernphysik). Nov. 1963. 70p.

Twelve monoenergetic gamma-ray-sources are used to obtain the response function for a 3 in. × 3 in. NaI crystal in the energy range 0.1 to 2.0 Mev. The analyzing program searches for groups of photo-peaks. They are fitted by sums of Gaussians, deciding their number by the statistical F-Test. Identified photo-peaks and the corresponding compton distributions are subtracted from the measured pulse-height spectrum, starting at high energies. A number of known spectra were analyzed in order to check the reliability of the procedure depending on counting rate, number of gamma-rays in a group, and their relative intensities and the number of subtractions. The results are discussed. (auth)

10378 (LNF-63/54(p.1-4)) DIGITALIZZAZIONE DI CAMERE A SCINTILLA. (Digitalization of Scintillation Chamber). G. Giannelli (Bari, Italy. Università. Istituto di Fisica).

In a scintillation chamber the electrical current in the discharge is very intense and brief, presumably from magnetopinch effects in the materials used. The primary results obtained from a study of such phenomena are reported, and the possibility of using them to locate the position of the spark in the scintillation chamber is investigated. In the study a device was used in which the electrode used to locate the spark was constituted of a system of parallel wires. The experimental set-up is shown, and the results obtained using Ni wire show that an elastic pulse is generated at the point of origin of the scintillation and this pulse can be used to determine the position of the spark. (J.S.R.)

10379 (LNF-63/54(p.8-15)) RISPOSTA AD ELETTRONI DI 450-1450 Mev, DI UNA CAMERA A SCINTILLA PROGETTATA PER LA RIVELAZIONE DI ELETTRONI PRIMARI NEI RAGGI COSMICI. (Response to Electrons at 450-1450 Mev of a Scintillation Chamber Designed for the Detection of the Primary Electrons in Cosmic Radiation). B. Agrinier, Y. Koechlin, B. Parlier (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay); G. Boella, G. Degli Antoni, C. Dilworth, L. Scarsi, and G. Sironi (Milan. Università. Istituto di Scienza Fisica and Italy. Istituto Nazionale di Fisica Nucleare, Milan).

In the design of a scintillation chamber to detect primary cosmic electrons, there are three principal problems: probable very low flux, presence of a flux of secondary electrons incident on the atmosphere, and presence of a secondary electron component produced in the atmosphere. A block diagram is given of the device designed and constructed to resolve such problems. The chamber was exposed in the Saclay proton synchrotron to a beam of negative pions. The efficiency for the recording of individual sparks in the chamber was determined as a function of single gaps, and the value obtained was 93%. The interaction paths in lead were determined for particles of the 1200 Mev/c beam. The electron energy was determined by analysis of the electron cloud. The results showed that the device was suitable for the purpose planned. (J.S.R.)

10380 (LNF-63/54(p.30-1)) PROGETTO PER RICERCHE SU GAMMA PRIMARI DIREZIONALI DI ALTA ENERGIA. (Project for the Investigation of High-Energy Directional Primary Gammas). D. Brini, U. Ciriegi, F. Fuligni, A. Gandolfi, and F. M. Gomide (Italy. Consiglio Nazionale delle Ricerche, Bologna).

A project for the study of the high-energy directional primary gamma is described based on a digitalized scintillation detector that permits the localization of the particle causing the scintillation. A schematic diagram of the device is shown and discussed. (J.S.R.)

10381 (SC-DC-64-268) DEVELOPMENT OF DIRECTIONAL DETECTOR FOR HIGH-ENERGY NEUTRONS. Final Report. C. P. Leavitt (New Mexico. Univ., Albuquerque). [Jan. 1964]. For Sandia Corp., Albuquerque, N. Mex. Contract [AT(29-1)-789]. 14p.

A directional detector for neutrons with energies of 40–120 Mev is described. Proton recoils generated by neutrons incident upon a hydrogenous material (scintillation plastic) are analyzed by scintillation counters scanned by photomultipliers. Plastic scintillation fluor surrounding the system and scanned by photomultipliers serves as an anticoincidence detector to eliminate charged particles. Coincidence circuitry identifies neutral particle events. Preliminary runs indicate an efficiency of about 1%, good recoil proton discrimination, and good directional response. (D.C.W.)

10382 (USAELRDL-TR-2342) THE MEASUREMENT OF HIGH INTENSITY GAMMA FLUXES WITH VAC ION GAUGES. Basil Markow (Army Electronics Research and Development Lab., Fort Monmouth, N. J.). Mar. 1963. 16p. (AD-402356)

A gamma detector capable of measuring the highly intense and rapidly changing fluxes of pulsed sources is described. The detector uses a readily available vac ion gauge and an easily constructed cable connector. Response curves are included. (auth)

10383 (USNRDL-ER-14) EVALUATION OF THE OXALIC ACID DOSIMETER FOR MEASURING MEGARAD DOSES OF GAMMA RADIATION. E. F. Connolly and L. H. Gevantman (Naval Radiological Defense Lab., San Francisco). Dec. 5, 1963. 18p. (AD-428607)

The oxalic acid dosimeter was tested for accuracy according to a procedure proposed by The American Society for Testing Materials, in three γ-dose ranges: 1.6-6, 6-18, and 18-50 megarads. The results were found to agree within a ±5-10% experimental error with values extrapolated from measurements by the Fricke dosimeter. (auth)

10384 (EURAEC-877) SPECTRUM INDEX DETECTORS. (Heavy Water). Special Report No. 14. J. Cherot, J. P. Frichet, P. Leger, and B. Sautiez (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 3742. 31p. (A translation)

The design, development, preparation, calibration, characteristics, and performance of spectrum index detectors are described. The detector is to be used in evaluating and studying fuel evolution and plutonium recycling problems. Information is also included on: experimental procedures, irradiation and counting conditions, analysis method, and decontamination. The use of the detector is shown by a study made on heavy water reactors containing natural uranium-filled rods. (N.W.R.)

10385 ANALYSIS OF BUBBLE CHAMBER DATA. Arthur H. Rosenfeld and William E. Humphrey (Univ. of California, Berkeley). Ann. Rev. Nucl. Sci., 13: 103-44 (1963).

An outline is presented of the 72-in. hydrogen bubble chamber system at Berkeley. Types of experiments using this type of system are reviewed. The economics of using bubble chambers is discussed. Automatic scanning and measuring devices and methods are discussed. 32 references. (R.E.U.)

10386 MODERN BUBBLE & SPARK CHAMBERS. Atomics, 17: 17-28(Jan.-Feb. 1964).

The detection, measurement, and interpretation of interactions brought about using high-energy accelerators are discussed with the development of bubble and spark chambers. Some representative examples of recently developed chambers are given. The design and construction of these chambers are discussed. (R.E.U.)

10387 NEUTRON DOSIMETRY BY THERMOLUMINESCENCE. A. J. Surjadi (Technische Hochschule, Munich). Atomkernenergie, 8: 435-7(Dec. 1963). (In German)

A thermoluminescent dosimeter is described, which is able to measure fast neutron dose. The fast neutrons are first moderated in a paraffin ball, which surrounds a detecting device. This device consists of a layer of CaF_2: Mn enveloped by a LiF-film. On neutron incidence, by reason of the (n,α) reaction, the CaF_2-layer is exposed to the α radiation. The integral thermoluminescent yield appearing thereby, on a supplementary heating of the layer, is a measure of the absorbed dose during the irradiation. The practical detecting limit is at a dose of 150 mrem fast neutrons, as was found by comparing with a calibrated neutron dosimeter. (auth)

10388 K^{40} AS STANDARD SUBSTANCE FOR RADIATION MEASUREMENT TECHNIQUES. Rolf Plesch (Siemens and Halske AG, Karlsruhe, Ger.). Atomkernenergie, 8: 438-44(Dec. 1963). (In German)

For measuring specific activities, detectors must be gaged in the measuring unit of the specific activity. A gaging substance for this purpose is K^{40}, which is mainly used as potassium chloride (KCl). It is cheap, easily available, has a very long half life, its beta and gamma

energies are in the medium range, and it is not subject to the stipulations of the first radiation protection regulation, being a naturally radioactive isotope. As a basis for subsequent investigations, the pulse rate for a gaging preparation made of a KCl solution and for a preparation made of KCl salt was calculated and compared to measurement results. There was almost complete agreement between calculation and measurement in the result; a relatively small deviation in the case of the salt is explained. The gaging constants for beta radiation was derived for the following technical measurement configurations: detector with lid foil, missing saturation thickness of the measuring preparation; detector without foil, missing saturation thickness of the measuring preparation; detector with lid foil, measuring preparation is available in saturation thickness; and detector without lid foil, measuring preparation is available in saturation thickness. It was always assumed that the gaging preparations are available in saturation thickness. Both definitions of specific activity, the definition referring to volume and the one referring to weight, were taken into consideration. Diagrams and examples are included. The gaging constants for gaging with the gamma radiation of K^{40} were not explicitly calculated. Reference was made to previous papers in which the basis for the energy conversions, which are necessary in this case, can be found. The statistical error in measurement of specific activities is discussed. (auth)

10389 USE OF 2,6-DICHLOROINDOPHENOL AS A DOSIMETER FOR COBALT-60 GAMMA RADIATION. DOSES OF 0.5 TO 30 KILORAD. Louis Gamoty and Lucien Brunelet. Chim. Anal. (Paris), 45: 641-6(Dec. 1963). (In French)

Solutions of 2,6-dichloroindophenol (2,6-DI) having variable concentrations, pH, and preparation conditions are studied, as regards their behavior in the dosimetry of Co^{60} gamma radiation. It is concluded that 2,6-DI is valuable as a gamma dosimeter in the 0.5 to 30 kr range, within the accuracy limits prevalent in industrial applications (such as irradiation techniques, applied chemistry, and feed technology.) The preparation and reading of these solutions, as well as their chemical stability, are outlined. (T.F.H.)

10390 SOLID-STATE DOSIMETERS BASED ON OPTICAL THEORY. Jozsef Patko (Kossuth Lajos Tudományegyetem, Debrecen, Hungary). Fiz. Szemle, 12: 1-8 (1962). (In Hungarian)

A comparison is made of applications of various dosimeters based on solid materials, and their comparative merits are described. Characteristics of the following types of dosimeters effective at various radiation intensities are discussed: condensation chambers for measurements over the range $10^{-4}-10^{2}$ rad, film dosimeters $10^{-1}-10^{5}$ rad, thermoluminescent types $10^{-3}-10^{4}$ rad, photoluminescent dosimeters $10^{1}-10^{4}$ rad, crystal types $10^{1}-10^{4}$ rad, glass dosimeters $10^{3}-10^{7}$ rad, synthetic material types $10^{5}-10^{9}$ rad, and luminescent degradation dosimeters $10^{5}-10^{8}$ rad. Special attention is given to the thermoluminescent dosimeter, which utilizes Mn-activated Ca phosphate. This dosimeter utilizes a glass ampulla instead of a glass vacuum tube and polarography is used to determine the luminescence curve. Simple evaluation equipment is being developed to be used with this dosimeter. Such thermoluminescent dosimeters are generally small in size. Its high sensitivity makes it applicable to low intensity radiation and after calibration it can again be utilized. Manganese-activated Ca phosphate dosimeters do not show any fading of response in the first hour after use. Use of solid dosimeters, for high-energy measurements (3 Mev and higher), is also discussed. (BBB)

10391 SEMICONDUCTOR RADIATION DETECTOR. Jitsuo Terada and Shigezo Yoshida (Tokyo Shibaura Electric Co., Ltd.). Genshiryoku Kogyo, 9: No. 8, 49-56(Aug. 1963). (In Japanese)

The performance of a Si detector and examples of its application are mentioned. The action mechanism of the Si detector is explained by comparatively simple equations, and the relation between bias voltage, particle ranges, and effective thickness of the Si detector are shown. By the use of this detector, a distinct α spectrum is obtained, which indicates that it is suitable as an α survey meter. This detector can be applied to neutron-monitoring on the basis of $Li^{6}(n,t)He^{4}$. It can be applied also as a dose-rate meter for high levels of radiation. The principle of the Li-drifted method is explained. This is the effective method of extending practical application of the detector to radiation other than α rays by enlarging the effective thickness. A Li-drifted Si detector manufactured for trial is also mentioned. (Nucl. Sci. Abstr. Japan, Vol. 2, No. 4.)

10392 THE AZIMUTHAL μ-MESON TELESCOPE OF THE KAZAKH STATE UNIVERSITY COSMIC-RAY STATION. L. V. Kozak, E. V. Kolomeets, L. A. Mirkin, B. A. Prilepskii and V. I. Roshchupkin (Kazakh State Univ., SSR). Geomagnetism Aeronomy, 2: 958-60(1962).

The azimuthal μ-meson telescope, designed for continuous recording of the directional intensity of the hard component in cosmic rays, is described. (R.E.U.)

10393 SPURIOUS SCATTERING AND DISTORTION IN NUCLEAR EMULSIONS. Prem K. Aditya (Indian Inst. of Tech., New Delhi). Indian Inst. of Tech. (Delhi), Phys. Bull., 48p. (Jan. 31, 1964).

Distortion was measured with special reference to spurious scattering in nuclear emulsions. Two methods are described by which distortion may be obtained in the plane of the tracks. A strong correlation was found between the distortion in the depth direction and that in the projected plane. The source of the former was traced to the nonplanarity of the pellicles while the latter was shown to consist of two components: one due to nonplanarity and the other due to processing effects. A procedure by which the component due to distortion can be eliminated is given; the level of spurious scattering is shown to be reduced from 2.5 to 1.1, times the true scattering. The characteristics of successive differences were considered in relation to the distortion. Agreement between expectations and experimental results was observed. (auth)

10394 DIRECTIONAL CHERENKOV DETECTORS FOR RELATIVISTIC PARTICLES. F. R. Arutyunyan, L. A. Ananova, and N. G. Grigoryan. Izv. Akad. Nauk Arm. SSR, Ser. Fiz.-Mat. Nauk, 16: No. 5, 118-23(1963). (In Russian)

The design of a Cherenkov threshold detector based on the principle of complete intrinsic reflection, not only at the base of the reflector but also at the sides, and capable of recording relativistic particles while simultaneously correctly fixing the direction of their path was investigated. (R.V.J.)

10395 DRIVE CIRCUITS FOR A SPARK CHAMBER. P. Autonès, J. Poinsignon, J. Rousseau, and J. Teiger (CEN, Saclay, France). J. Phys., 24: Suppl. to No. 10, 147A-52A(Oct. 1963). (In French)

Electronic triggering circuits for a spark chamber are described. They consist of a high-voltage pulse generator, which uses 5C22 thyratrons; a dead-time circuit for determining the minimum time between two firings of the chamber; and auxiliary triggering circuits for the camera and the recording of the indicative data (frame number, number of particles, etc.) presented as luminous figures. This permits the simultaneous illumination of a reference grid

placed in front of the chamber. The circuits are triggered by a gate signal synchronized with the accelerator. (auth)

10396 ON THE POSSIBILITIES OF APPLYING THE OPTIMUM FILTERING THEORY TO THE CONCEPTION OF ELECTRIC AMPLIFIERS FOR PRECISION IN NUCLEAR SPECTROMETRY. B. Escudié, R. Chéry, and J. Gréa (Institut de Physique Nucléaire, Lyon). J. Phys., 24: Suppl. to No. 10, 183A-8A(Oct. 1963). (In French)

A method for deriving low-noise-detector amplifiers is discussed. Wiener optimum filtering allows computation of the electric characteristics of a "linear filtering stage." The low theoretical noise level showed that the use of Wiener filtering can improve the accuracy of nuclear spectrometry. The main problem is the practical construction of a Wiener filter. Using a half sine wave as input signal, it appears that the filter synthesis is near that of a wide band with tuned circuit. An approach to a Wiener filter can be made using high frequency transformers. (auth)

10397 FAST COINCIDENCE CIRCUIT UTILIZING TRANSISTORS IN SATURATED REGION. J. Dufournaud (Faculte des Sciences, Orsay, France). J. Phys., 24: Suppl. to No. 10, 189A-91A(Oct. 1963). (In French)

A transistorized fast circuit, working in the saturated region, giving good resolution and high stability, and capable of being combined and used with more or less complicated systems of scintillation detectors is described. (auth)

10398 LINEARITY CHARACTERISTICS OF MULTIPLIER PHOTOTUBES. Mamoru Nonaka and Takeo Kashima (Hitachi Central Research Lab., Tokyo). Japan. J. Appl. Phys., 2: 785-91(Dec. 1963).

The linearity characteristics of multiplier phototubes with side-window type of photocathodes were investigated, and the following results obtained. The departure from linear response depends on the wavelength of incident light and the supply voltage between the anode and the photocathode, and becomes large for flux incident upon the edges of the photocathode. The state of polarization of incident light does not affect the linearity. (auth)

10399 OSCILLATION OBSERVED IN SILICON SURFACE-BARRIER DIODES UNDER PULSIVE ELECTRON BOMBARDMENT. Sadahiko Yamashita, Eiichi Miyazaki, and Kohichi Miyaji (Matsushita Research Inst. Tokyo, Inc.). Japan. J. Appl. Phys., 2: 806-7(Dec. 1963).

The observation of oscillations in silicon–gold photodiodes under pulsed electron bombardment, where the diameter of the spot of the electron beam was 1 mm and the accelerating voltage and bombarding current were 2 to 50 kv and 10^{-8} to 10^{-5} amp, respectively, is reported. (R.E.U.)

10400 THE EFFECT OF FOCUSING VOLTAGES ON THE RESOLVING POWER OF PHOTOMULTIPLIERS. Heinz Graber. Jena Rev., No. 3, 131-6(1963).

For the JENA multiplier types M 12 FS 35, M 12 FS 60, and M 12 FS 100, as well as for type M 12 FS, investigations are carried out on the dependence of the energy resolution and the multiplication coefficient on the voltage ratios in the transmission system between the photocathode and the second dynode. For each type the most favorable electron-optical working conditions are given. (auth)

10401 NEW PHOTOMULTIPLIER FOR PHOTOMETRY AND NUCLEAR MEASURING TECHNIQUES. Hans-Joachim Pohl. Jena Rev., Special Fair Issue, 45-50(1963).

The development of photomultipliers for objective photometry and radiation detection techniques with an extremely sensitive measuring element for radiation of all wavelengths is discussed. The spectral range, cathode size, signal-to-noise ratio, and time behavior are considered. (C.E.S.)

10402 RESPONSE OF GAMMA SCINTILLATION DETECTORS FOR FIELD SURVEY USE. Charles M. Proctor, Andrew R. Lowrey, Emanuel Papadopulos, and John R. Penning, Jr. (Boeing Co., Seattle). Limnol. Oceanog., 7: 273-9(July 1962).

Gamma scintillation spectra were obtained with several sizes of NaI(Tl) crystal, Pilot B plastic, and liquid detectors which were immersed in solutions of gamma-emitting nuclides contained in a 2,300-gal tank. The count rates for gamma photons in the Mev energy range were proportional to detector volumes. Integral count rates with plastic and liquid detectors were, respectively, 39% and 33% of the rate with NaI(Tl). Factors in the selection of detectors for field use are discussed. (auth)

10403 GAMMA SCINTILLATION PROBE FOR FIELD USE AND MEASUREMENTS OF RADIATION BACKGROUND IN PUGET SOUND. Charles M. Proctor, Emanuel Papadopulos, and Ralph H. Firminhac (Boeing Co., Seattle). Limnol. Oceanog., 7: 280-6(July 1962).

A probe containing a 5 × 4-in. NaI(Tl) crystal was built for field survey work with a small ship and portable counting equipment. The gamma radiation background was measured to a depth of 80 m at 3 locations in the lower part of Puget Sound. The count rate decreased very rapidly and nonlinearly in the first few meters below the water surface. Precise control of detector depth is thus essential when measurements are being made near the surface. After background corrections have been made, the integrated gamma fluxes above 0.25 and 1.6 Mev follow published curves for cosmic-ray attenuation quite closely. (auth)

10404 ON THE ABSOLUTE DETERMINATION OF THE ROENTGEN UNIT IN THE REGION OF Co^{60} γ RADIATION. A. Rakow and W. Will (Institut für Biophysik, Deutsche Akademie der Wissenschaften, Berlin). Monatsber. Deut. Akad. Wiss. Berlin, 5: 462-6(1963). (In German)

A dosimeter comparison in the energy region of Co^{60} γ radiation showed that the indicators in various clinics and institutes for dose measurements on Co^{60} irradiators vary by as much as 30%. Therefore an ionization chamber was built of graphite and aluminum, with which the absolute determination of the roentgen unit was possible. The corrections established for the measured results are given. The error in the absolute dose measurements with the described chamber amounts to about 2.5%. A comparison with earlier measurements by the National Research Council of Canada gave a deviation of 0.9%. (M.C.G.)

10405 ON THE RANGE OF APPLICATION OF THE STANDARD METHODS FOR BETA DOSE DETECTION. D. Herrmann and C. F. Weiss (Institut für Angewandte Radioaktivität, Deutsche Akademie der Wissenschaften, Leipzig). Monatsber. Deut. Akad. Wiss. Berlin, 5: 482-9(1963). (In German)

Discrepancies in standard methods for beta dosimetry are discussed. Theoretical explanations of the causes of errors are considered. Conclusions were made regarding the applications of various standard methods. (M.C.G.)

10406 THE EFFECTS OF GAMMA-RAYS ON THE NEUTRON DETECTORS. Yoshiyuki Nakashima (Government Industrial Research Inst., Nagoya, Japan) and Mineo Kasai. Nagoya Kogyo Gijutsu Shikensho Hokoku, 12: 450-4(Sept. 1963). (In Japanese)

In many cases, neutron detection must be carried out in a high gamma-ray background, for instance, around a nuclear reactor or around neutron sources involving (α,n) or

(γ,n) reactions. Under these circumstances the neutron spectra cannot be observed owing to the pile-up of pulses due to gamma rays. In practice a discrimination method is being adopted to cut off the gamma rays in ordinary measurements. In this experiment, the following neutron detectors are examined to find the upper limit of gamma-ray background: 1) Li^6I (Eu) scintillator, 2) thermal neutron detector, 3) $B^{10}F_3$ (proportional) counter. One result shows that it is impossible to measure the spectrum (for thermal neutron) by Li^6I (Eu) scintillator when the dose rate due to gamma rays reaches 1.5 r/hr. (auth)

10407 THEORETICAL AND EXPERIMENTAL STUDY OF FATIGUE IN PHOTOMULTIPLIER TUBES. I. Cantarell (Puerto Rico Nuclear Center, Mayaguez). Nucl. Sci. Eng., 18: 31-48(Jan. 1964).

The results of a systematic qualitative and quantitative study of the little understood phenomenon of fatigue in photomultiplier tubes are presented. A precision of 0.4% was obtained in the measurements. After determination of the variables that affect fatigue and the mathematical dependence of fatigue with each of them, the general properties of fatigue and the nature and mechanism of the effect are discussed. Photomultiplier fatigue appears as a field emission from the dynode bombardment, probably combined with diffusion or conductivity through the thin insulator film of the dynode surface. (auth)

10408 SELF-POWERED NEUTRON DETECTORS FOR REACTOR FLUX MONITORING. John W. Hilborn (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucleonics, 22: No. 2, 69-72; 74(Feb. 1964).

A neutron detector made from coaxial cable for in-pile reactor application is described. The current set up in the detector comes from neutron-induced radioactivity and is, therefore, essentially self-powered. Operational data and design are given for instruments using Al^{27}, V^{51}, Rh^{103}, In^{115}, Ag^{109}, Mn^{55}, U^{238}, and U^{235} as emitters. (D.E.W.)

10409 LOW NOISE CHARGE-SENSITIVE PREAMPLIFIER FOR USE WITH SEMICONDUCTOR NUCLEAR RADIATION DETECTOR. Miroslaw Dakowski and Mieczyslaw Sowinski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 8: 280-4(1963). (In Polish)

The preamplifier described is based on the design of E. Fairstein (IRE Trans. NS-8, 129 (1961)). The numerous design changes include the optimization of the relative values of time constants such as overall rise-time and clipping times in the interstage R-C networks, the inclusion of selector switches to allow variation of the time constants according to the use of the preamplifier, the use of input amplifier tubes that have good noise characteristics, the optimization of tube voltages, the use of low-temperature-coefficient resistors and capacitors, and housing in a heavy copper-sheet chassis. The preamplifier sensitivity is given as 1.33×10^{13} volt per coulomb or 0.25 volt per mev. The noise level for an input capacitance of 20 to 100 picofarads is about 4 to 8 kev, respectively. (TTT)

10410 LINEARITY OF PHOTOMULTIPLIERS: EFFECT OF DYNODE CURRENTS. P. Moatti. Onde Elec., 43: 787-93(July-Aug. 1963). (In French)

The amplification of cathode current of a photomultiplier with the classic circuit, with one high-voltage supply, and by-pass capacitors, cannot be linear, owing to the effect of dynode currents. The variation of load dynode potentials is calculated, as well as the resulting gain distortion. Two new gain-regulating designs are proposed, using two high-voltage supplies. Output is made at the anode, or at a definite dynode. The circuits give a high linearity with respect to amplitude and frequency. (auth)

10411 TRACK REGISTRATION IN VARIOUS SOLID-STATE NUCLEAR TRACK DETECTORS. R. L. Fleischer (General Electric Research Lab., Schenectady, N. Y.), P. B. Price, R. M. Walker, and E. L. Hubbard. Phys. Rev., 133: A1443-9(Mar. 2, 1964).

In a number of materials energetic, heavy nuclear particles leave trails of radiation-damaged material that can be selectively attacked by chemical reagents to produce tracks visible in the optical microscope. The track-registration characteristics of three such materials—muscovite mica, Lexan polycarbonate, and cellulose nitrate—were investigated using fission fragments and various heavy ions from argon down to helium, each over a wide range of energies. Curves of energy-loss rate dE/dx versus particle energy were calculated for each solid, and the experimental results were displayed on the dE/dx curves. It was found that for each detector there is a fairly narrow range of dE/dx values over which the track-registration efficiency varies from unity to zero. This rapid drop in efficiency with dE/dx makes it reasonable to define a critical energy-loss rate $(dE/dx)_{crit}$ for each detector, which appears to be independent of energy and atomic number. Crude estimates of particle masses can be made using several detectors with different $(dE/dx)_{crit}$. For example, for particles with energies less than ~3 Mev/amu, the mass must exceed 3, 12, and 28 amu if tracks register in cellulose nitrate, Lexan polycarbonate, and muscovite, respectively. For particles such as fission fragments, with initial $dE/dx \gg (dE/dx)_{crit}$, the track lengths are a fair approximation of the particle ranges. Particles incident at a very small angle to a detector surface are registered in mica but not in plastics or glasses. Solid-state track detectors presently offer unique advantages when heavy particles must be studied in the presence of a high background flux of light particles. (auth)

10412 OPERATIONAL DATA OF THE ONE-WINDOW ALCOHOL G-M COUNTERS POLISH PRODUCTION. Wieslaw Zak. Przeglad Elektron., 4: 343-7(1963). (In Polish)

Data are presented on both new and used G-M counters in terms of operational life, sensitivity, stability, and shape of the plateau of the counters. The counters were studied both with and without quenching circuits. Two types of quenching circuits were used, and the effectiveness of these were compared. The results demonstrate the importance of quenching circuits to good operational characteristics such as counter lifetime (in terms of counts), stability, and flatness of plateau. (TTT)

10413 THE GENEVA WHOLE-BODY COUNTER. P. Wenger (Institut du Radium, Geneva). Radiol. Clin., 32: 411-16(1963). (In French)

With this counter, which is described and illustrated, spectra are obtained using an entirely transistorized RCL spectrometer of 256 channels. A Harshaw crystal 20 cm in dia and 10-cm thickness, joined to 3 photomultipliers, forms the scintillation detector and 2 adjoining calculators permit a rapid computation of results. The 2-m high, 3-m long, 2-m wide, and 18-cm thick walls of the steel counting chamber are made from Fe (from rails made before 1930) smelted in a radioactivity-free foundry, and are lined by 2 mm of Pb particularly low in radioactivity. It was concluded that the Geneva whole-body counter has greatly enlarged the field of application of medical radioactivity. (TCO)

10414 THE POLYACRYLAMIDE DOSIMETER. R. F. Nelson and R. J. Schulz (Albert Einstein Coll. of Medicine, New York). Radiology, 82: 120-4(Jan. 1964).

The dosimetric properties of polyacrylamide (PAM) were investigated. It was found that this dosimeter is energy-independent from 280 kvp to 35 Mev; is dose-rate-independent between 6 and 150 rads/min; and has a sensitivity of 6 per cent decrease in viscosity per 100 rads. It is anticipated that this dosimeter will be a valuable supplement to those presently being used. It will be a useful tool in radiation therapy to obtain the dose measurements to such locations as the bladder and rectum; in radiobiology, to determine the average absorbed dose to various animals, not only for whole-body irradiation, but also to specific organs; and in radiological physics, for direct measurement of absorbed dose. (auth)

10415 NEW TECHNIQUE FOR DESIGNING FAST RISE TRANSISTOR PULSE AMPLIFIERS. Charles J. Rush (Argonne National Lab., Ill.). Rev. Sci. Instr., 35: 149-56 (Feb. 1964).

A unique fast amplifier configuration is presented. With this configuration a design for a given gain and risetime can be accomplished using transistor parameters normally given on the manufacturer's data sheet. A five-stage amplifier having a gain of 1580 and a risetime of 3.05 nsec was built using the technique. (auth)

10416 DETECTION OF SCINTILLATION PHOTONS WITH PHOTODIODES. C. Y. Fan (Univ. of Chicago). Rev. Sci. Instr., 35: 158-63(Feb. 1964).

A statistical theory on the efficiency of collection of scintillation photons from a scintillator by a photon detector was developed. If A_0 is the total surface area of the scintillator, A the surface area of the portion of the scintillator to which the detector is coupled, η the diffuse reflectivity of the material into which the scintillator is packed, K the probability that a photon impinging on A is absorbed by the photon detector, the photon collection efficiency is $\epsilon = KA/A_0\{1/1 - \eta[1 - (KA/A_0)]\}$. An experimental determination of the value of ϵ was made with a photodiode CsI(Tl) unit, which was constructed primarily as a cosmic ray detector used in space vehicles. The CsI(Tl) crystal was packed in a case of high reflectance surface (η = 94%) and coupled to two Au–Si surface barrier photodiodes with LTV 602 clear silicone potting compound. The experimental value is about 30%, which is in reasonable agreement with the theory. The dispersion of the signal out (full width at half-maximum) of this unit for the detection of 40-Mev α particles is 75 kev at 495 kev. It is comparable with what is obtained with a CsI(Tl)-photomultiplier tube combination. (auth)

10417 VELOCITY SPECTROMETER FOR MÖSSBAUER EXPERIMENTS. E. Kankeleit (California Inst. of Tech., Pasadena). Rev. Sci. Instr., 35: 194-7(Feb. 1964).

An electromechanical feedback system for Mössbauer spectroscopy with a velocity range of 2×10^{-5} to 60 cm/sec is described. A reference signal of the desired waveform (triangle, parabola, etc.) to drive the feedback system is produced by the multichannel analyzer and with the help of operational amplifiers. The linearity of the system for a triangular velocity waveform is better than 0.5% during 98% of the half-period. (auth)

10418 NUCLEAR PULSE ENHANCEMENT IN SILICON P-N JUNCTION RADIATION DETECTORS. Robert J. Grainger and Norman A. Baily (Hughes Research Labs., Malibu, Calif.). Rev. Sci. Instr., 35: 232-3(Feb. 1964).

Pulse enhancement was obtained for X and γ rays, electrons, and α particles in silicon p-n junction detectors. The enhanced pulses were characterized by long rise and decay times. Both rise and decay times were of the order of 10 μsec for those pulses undergoing maximum enhancement. Both rise and decay times decreased with increasing bias and were accompanied by a decrease in pulse height. (C.E.S.)

10419 ALUMINIZED POLYSTYRENE LIGHT PIPES. Paul Mockett (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr., 35: 238(Feb. 1964).

Hollow tubes made of thin aluminized polystyrene sheets were used to pipe light from scintillation and Cherenkov radiators to photomultipliers. The light collection was found to be more than adequate in the geometries tested. (C.E.S.)

10420 SIMPLE GAS CIRCULATION PUMP. K. L. Erdman, J. R. MacDonald, G. A. Beer, and D. A. Axen (Univ. of British Columbia, Vancouver, Can.). Rev. Sci. Instr., 35: 241(Feb. 1964).

A pump with a small volume and relatively high rate of gas circulation for purifying gases in ionization chambers, proportional counters, and gas scintillation counters, is described. (C.E.S.)

10421 CaI_2 AND CaI_2(Eu) SCINTILLATION CRYSTALS. R. Hofstadter (Stanford Univ., Calif.), E. W. O'Dell, and C. T. Schmidt. Rev. Sci. Instr., 35: 246-7(Feb. 1964).

The scintillation and other physical properties of CaI_2 and CaI_2(Eu) crystals are presented. The gamma spectra of Co^{57} and Cs^{137} obtained with these crystals are illustrated. The resolution performance is compared with other scintillation crystals. (C.E.S.)

10422 EFFICIENCY OF SECONDARY EMISSION MONITOR AT ELECTRON ENERGIES FROM 15 TO 70 Mev. I. O. Grishaev, O. V. Dem'yanov, D. I. Sikora, and B. I. Shramenko (Khar'kov Inst. of Physics and Tech.). Ukr. Fiz. Zh., 8: 1029-30(Sept. 1963). (In Ukrainian)

The efficiency of a secondary emission monitor was studied as a function of electron energy between 15 and 70 Mev. A Faraday cylinder and a secondary emission monitor were connected to separate integrators. A narrow electron beam focused on the monitor, consisting of two sets of aluminum foils, was completely absorbed by the Faraday cylinder. The monitor exhibited consistent efficiency for 15 to 70 Mev. The mean efficiency was $R_c = 0.465 \pm 0.006$. (R.V.J.)

10423 GASEOUS CHERENKOV COUNTERS. A. S. Vovenko, B. A. Kulakov, M. F. Likhachev, Yu. A. Matushenko, I. A. Savin, and V. S. Stavinskiĭ. Usp. Fiz. Nauk, 81: 453-506(Nov. 1963). (In Russian)

The differential gaseous Cherenkov counters are based on the collection of the light by an optical system on a photomultiplier tube which transforms it into electrical pulses. As the sensitivity of the optical system is limited to a narrow angular region, the signal possesses a sharp peak. The background radiation is due to various other phenomena, such as the Cherenkov radiation of the incident δ-electrons and of the secondary particles formed by nuclear interactions, diffraction and multiple scattering of the particles, molecular scattering of light, collision-induced energy losses of the particles, scintillation of the gas, and bremsstrahlung. Many gases were used for building these counters; they include H_2, O_2, N_2, air, NO_2, CO, NH_3, CH_4, CO_2, freon, N_2O, H_2S, SO_2, C_2H_4, C_2H_6, SF_6, $CHCl_3$, etc. Ethylene at 20°C and 50 atm. pressure is closest to the critical point and thus has the largest index of refraction. The first instruments of this type were threshold counters; later differential counters were de-

veloped with an optical system recording particles emitting light at an angle of about 10° with respect to the direction of motion. These counters were used for determining the total cross section of π^+ and K^+ mesons with protons. Sixty-seven references are given. (TTT)

10424 SEMICONDUCTOR DETECTORS OF NUCLEAR EMISSIONS. E. L. Stolyarova. Usp. Fiz. Nauk, 81: 641-68(Dec. 1963). (In Russian)

Descriptions are given of the physical properties, technology, construction, and basic parameters of various semiconductor detectors used in nuclear physics. (R.V.J.)

10425 SCINTILLATION METHODS FOR MEASURING (γ,p) REACTIONS. V. G. Shevchenko and B. A. Yur'ev. Vestn. Mosk. Univ., Ser. III, Fiz., Astron., No. 5, 11-17 (Sept.-Oct. 1963). (In Russian)

Descriptions are given of a scintillation spectrometer with a thin CsI(Tl) crystal developed for measuring cross sections and angular distributions in photoproton reactions at 35 Mev. The spectrometer proved efficient even in strong electron and γ backgrounds. Measurements of (γ,p) reaction cross sections for tungsten are included. (tr-auth)

10426 AUTOMATIC ANALYSING APPARATUS FOR NUCLEAR EMULSIONS. P. Koeppe. Thesis, Berlin, Technische Hochschule, 1961. 81p. $2.00. (Gmelin, AED-DISS. 61-352).

The construction of an automatic system for counting tracks in nuclear emulsions is described. With this instrument track counting in all directions is possible. Errors from emulsion inhomogeneities are reduced by an anticoincidence method. Applications for neutron dosimetry are discussed. (Gmelin Inst.)

10427 EVALUATION OF A WATER SHIELD-WHOLE BODY COUNTER. Richard E. Peterson, Eugene V. Weiner, and William S. Cook, Jr. (Univ. of Iowa, Iowa City and Veterans Administration Hospital, Iowa City, Iowa). (CONF-362-1)

From 2nd Symposium Radiochemistry in Man, Chicago, Sept. 1962.

A low-background water-shielded room for human gamma spectrometry is described. Body K^{40} content was determined. The background within this room with $\frac{1}{8}$ in. lead added-shielding around the crystal was 845 cpm in the region of 0.1 to 2.0 Mev. This background, obtained with a 9- by 5-inch NaI crystal, is significantly lower than that obtained with other crystals of comparable volume. Part of this low background is due to a crystal relatively free of radioactivity. Use of quartz photomultipliers should bring about further reduction in background. A large part of the favorable background is due to the shielding characteristics of the water mass. The shielding advantages over other materials are both in less radioactivity contamination in the shield and in diminishing cosmic ray contributions. Possibilities for further reduction in cosmic ray contributions are discussed. (auth)

10428 MEASURING AND REGISTERING APPARATUS FOR IONIZING RADIATION. Rolf Maximilian Sievert. German Patent 1,153,121. Aug. 22, 1963. Priority date Apr. 13, 1960, Sweden.

The apparatus comprises an ionization chamber, an electrometer tube whose control grid is connected with the central electrode of the ionization chamber, and an electromagnet that responds automatically after a predetermined dose is absorbed (this dose resulting in a corresponding control grid voltage). A description of the electromagnet is given. (Gmelin Inst.)

10429 METHOD FOR MONITORING CONTINUOUSLY RADIOACTIVELY CONTAMINATED WATER AND APPARATUS FOR CARRYING OUT THIS METHOD. Rolf Plesch (to Siemens and Halske AG). German Patent 1,153,195. Aug. 22, 1963. Filed Aug. 5, 1958.

The method comprises spraying the water with the help of an electrostatic field upon a heated metallic band; evaporating the water from the band; and moving the band in front of a detector. The spray nozzles are pointed in order to generate a high electric field density with regard to the conducting band. (Gmelin Inst.)

10430 SYSTEM FOR CONTINUOUSLY MONITORING THE RADIOACTIVITY OF FLUIDS. Davis R. Dewey. U. S. Patent 3,117,842. Jan. 14, 1964. Filed Feb. 23, 1960.

Electrolytic dissociation is used to concentrate radioactive materials on either side of a flow channel where electropositive and electronegative surfaces are provided. Flow regulators and radiation detectors are included. Application is made to large water supply systems containing ionic radioactive materials. (R.E.U.)

10431 PHOTOCONDUCTIVE TYPE IONIZING RADIATION DETECTOR. Frank H. Attix. U. S. Patent 3,119,016. Jan. 21, 1964. Filed May 29, 1961.

The response characteristics of photoconducting materials such as cadmium sulfide are improved and larger photocurrents are obtained from short duration exposure. A semiconductor detector is included in a light-opaque envelope with the proper circuitry to indicate any ionizing radiation. A luminescent material is positioned relative to the semiconductor element and produces a continuous low-level light source for the detector. Radiation is detected both directly (incident on semiconductor) and indirectly (incident on luminescent material). (R.E.U.)

ISOTOPE TECHNOLOGY

General

10432 (TID-4202) ISOTOPE DEVELOPMENT PROGRAM—CONTRACT SCOPE STATEMENTS. (Division of Isotopes Development, AEC). Sept. 1963. 116p.

A compilation of scope statements is presented on projects supported by the Division of Isotopes Development. The projects are arranged in groups dealing with radioisotope and fission product production and separations, isotopic power fuels, radiation pasteurization of foods, process radiation, and radioisotope technology. Author, subject, and contractor indexes are included. (D.L.C.)

Industrial Applications

Refer also to abstract 10234.

10433 (AED-C-01-04) AUSGEWAHLTES SCHRIFFTUM NACH SACHGEBIETEN. BAUWESEN. ANWENDUNG RADIOAKTIVER ISOTOPE IN DER BAUTECHNIK. BIBLIOGRAPHISCHE ZUSAMMENSTELLUNG. (Selected Literature According to Subject Field. Architecture. Application of Radioactive Isotopes in Building Techniques. Bibliographic Compilation). (Fraunhofer-Gesellschaft, Stuttgart). Sept. 1963. 98p.

Three hundred twenty-one references on the use of radioisotopes in building techniques are presented. A subject index and an author index are included. (M.C.G.)

10434 NEW FACILITIES AND EQUIPMENT FOR RADIATION STERILIZATION. John W. Olander (High Voltage Engineering Corp., Burlington, Mass.). Bull. Parenteral Drug Assoc., 17: 14-21(Jan.-Feb. 1963).

A description is given of the construction of the largest service irradiation facility in the world, which, when completed in early 1963, will contain 4 accelerators of various energies with a total power of over 33 kw for generating ionizing radiation. A cutaway drawing of new facility is shown, a building, containing 14000 ft^2 of floor space, devoted solely to contract irradiation work. The accelerators will operate at energies of 500 kv and 1, 1.5, and 3 Mev, permitting selection of the appropriate machine for maximum penetration efficiency and, therefore, optimal production economics. The 1-Mev accelerator is of the insulating core transformer (ICT) type with a power output of up to 20 kw. To keep the necessary conveyor speeds at a modest level, it is equipped with a beam deflection system capable of spanning a 30-in. conveyor. A neighboring vault will house a 3-Mev, 3-kw Van de Graaff accelerator, also equipped for straight-through passage of materials with a scan capability of up to 20 in. The fourth accelerator is a 500-kv ICT to be utilized for high speed processing of plastic films or other low-density materials and will be equipped with a 48-in. scanner. General concepts of the ICT multiple beam accelerator are discussed. (TCO)

10435 RADIATION STERILIZATION OF ORANGE JUICE. S. D. Dharkar (Atomic Energy Establishment, Trombay, India). Indian J. Technol., 2: 24-6(Jan. 1964).

Effective sterilization of orange juice was achieved by subjecting it to a radiation dose of 8×10^5 rads or to a radiation dose of 4×10^5 rads followed by incubation for 15 min at 50°C. Ascorbic acid, thiamine, and riboflavin in the juice are destroyed to a greater extent by irradiation alone than in the combined irradiation-incubation treatment. Irradiation under oxygen or nitrogen atmosphere does not influence the survival of spoilage organisms. The color change in the juice due to irradiation is minimized under nitrogen atmosphere. (auth)

10436 LOW-DOSE IRRADIATION PROCESSING OF FOOD. Kevin G. Shea. Nucl. News, 7: No. 2, 10-16(Feb. 1964).

A review is presented on low-dose radiation processing of food. Irradiation facilities; economics; the pasteurization process for marine products, fruits, and vegetables; packaging; and wholesomeness are discussed. (P.C.H.)

10437 APPLICATION OF RADIOISOTOPES IN POLAROGRAPHY. NOTE II. A RADIOACTIVE SILVER MICROCOULOMETER. Loris Busulina and Enrico Naldi (Università, Padua; CNR, Padua; CNEN, Padua; and CNR, Bologna). Ric. Sci., Rend., Sez. A, 3: 807-12(Sept. 1963). (In Italian)

A microcoulometer, which uses radioactive silver, is described. It is suitable for the determination of current quantities as high as 5×10^{-4} coulombs with a ±2% error. The coulometric cell and the working conditions are described. (auth)

Separation and Production

Refer also to abstract 11496.

10438 (ORNL-TM-736) ISOTOPIC SEPARATIONS. Progress Report, July–September 1963. L. O. Love, comp. (Oak Ridge National Lab., Tenn.). Jan. 16, 1964. Contract [W-7405-eng-26]. 31p.

Cadmium isotopes were separated in the 255° separator to provide inventory samples and to provide data for evaluating the inhomogeneous field system. It was found that by shaping the magnetic field to eliminate higher radial angular aberrations from the magnetic lens, a significant improvement in isotopic purities was achieved. Reliable evaluation of a 180° sector instrument with 0.5 magnetic field inhomogeneity was achieved. Study of the magnetic field system revealed that the source can be inclined at an angle with respect to the magnetic face to compensate for fringing magnetic field effects. An improved feed system to control vapor flow to the arc during electromagnetic separations of mercury is reported. A method of determining the impinging material concentration during preparation of gaseous target elements for ion bombardment was developed. In calutron system studies, factors which control the beam focal point were examined. Conclusions concerning these factors are discussed, along with findings in ion beam spectrographic analyses and findings concerning isotopic contamination causes. The use of SiS as a charge feed permitted the simultaneous collection of Si^+ and S^+ beams. Information concerning charge preparation is included along with data on current isotope separations. Data and information concerning Pu separations are included along with data on purification of depleted U^{238}. Developmental work related to thermal diffusion of Ne^{21}, Ar^{38}, C^{13}, Kr^{86}, and Xe^{124} is reported. (J.R.D.)

10439 (JPRS-23279) PRODUCTION OF RADIOACTIVE ISOTOPES AT THE "BORIS KIDRIC" INSTITUTE IN VINCA. Cedomir Teofilovski and Zdenko Dizdar. Translated from Tehnika (Belgrade), 19: No. 1, 25-32(Jan. 1964). 17p. (OTS-64-21586)

Data are presented on the production of radioisotopes in the last two years at Vinca, Yugoslavia, and the trends of further development of the production are indicated. The methods, techniques, and problems involved in the production are described. Among the materials produced are S^{35}, P^{32}, I^{131}, Au^{198}, Cr^{51}, Zn^{65}, Na^{24}, K^{42}, and Fe^{59}. (D.L.C.)

10440 WHY THE GS PROCESS STILL TOPS COMPETITORS. Charles A. Law. Can. Nucl. Technol., 3: 36-40(1964).

The economics of the GS process are evaluated, and possible competitors are discussed. (C.E.S.)

10441 TOTAL FLOW RATES IN AN ISOTOPE SEPARATION SYSTEM. Alexander Apelblat and Gideon Pery (Israel Atomic Energy Commission, Tel-Aviv). Ind. Eng. Chem., Fundamentals, 3: 83-5(Feb. 1964).

A cascade for isotope separation, working with constant cut numbers and a given number of stages for a desired enrichment, is treated. A simple general calculation of a material cascade balance in any intermediate stage is presented for the above conditions. The choice of cut numbers is also discussed. (auth)

10442 SOME ISOTOPE FRACTIONATION FACTORS FOR SULFUR. A. C. Rutenberg and J. S. Drury (Oak Ridge National Lab., Tenn.). J. Chem. Eng. Data, 9: 43-4(Jan. 1964).

Isotopic fractionation factors were measured for the reaction: $S^{34}O_2(g) + A \cdot S^{32}O_2(l) = S^{32}O_2(g) + A \cdot S^{34}O_2(l)$, where A was aniline, dimethylaniline, triethylamine, pyridine, and ethylene oxide. Similar measurements were made for the KH_2PO_4 buffered reaction: $S^{34}O_2(g) + HS^{32}O_3^-(l) = S^{32}O_2(g) + HS^{34}O_3^-(l)$ and for the distillation of SO_3. The fractionation factors ranged from 1.0005 to 1.005 with the heavy isotope concentrating in the liquid phase. (auth)

10443 ENRICHMENT OF CHROMIUM-51 BY SZILARD-CHALMERS PROCESS. Chung-Hsiung Tsai and Si-Jung Yeh (National Tsing Hua Univ., China). J. Chinese Chem. Soc. (Taiwan) (2), 10: 16-23(Mar. 31, 1963).

Enrichment of chromium-51 by the Szilard-Chalmers process was studied, using potassium and ammonium chromate as target materials. Separation of enriched phase from the target was carried out by ion exchange method. An enrichment factor as high as 3000 was attained for a potassium chromate target. When ammonium chromate was used as the target, the enrichment factor was much lower, amounting only to 150. (auth)

10444 SEPARATION OF OXYGEN AND CARBON ISOTOPES IN CO_2 DECOMPOSITION BY QUIET ELECTRIC DISCHARGE. I. A. Semiokhin, Yu. P. Andreev, and G. M. Panchenkov (Moscow State Univ.). Zh. Fiz. Khim., 37: 2782-3(Dec. 1963). (In Russian)

Dissociation of CO_2 by electric discharge and oxygen and carbon isotope distributions in the dissociation were studied. With specific energy (u/v) variations from 1 to 2 up to 40 to 50 w/l/hr the dissociation varied from 1.5 to 20%, and effective separation coefficients increased from 1.03 to 1.2 for O^{18} and from 1.025 to 1.15 for C^{13}. (R.V.J.)

10445 METHOD FOR THE ENRICHMENT OF DEUTERIUM IN AMMONIA BY ISOTOPIC EXCHANGE BETWEEN HYDROGEN AND AMMONIA IN THE PRESENCE OF POTASSIUM AMIDE. Albert R. Kenyon and Arthur J. Birch (to United Kingdom Atomic Energy Authority). German Patent 1,152,999. Aug. 22, 1963. Priority date Feb. 4, 1960, Great Britain.

The fluid ammonia that is to be contacted with the hydrogen contains, in addition to the amide catalyst, a primary or secondary aliphatic amine. (Gmelin Inst.)

MATHEMATICS AND COMPUTERS

10446 (JINR-P-1460) ESHCHE OB IDEOGRAMME. (Once Again on Ideogram). G. I. Kopylov and M. I. Podgoretskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1963. 6p.

The dependence of the mean abscissa of the maximum in the ideogram of the Gaussian distribution is derived as a function of the number of measurements used in constructing the ideogram. The calculations are made by the Monte-Carlo method. (auth)

10447 (ORNL-TM-659) SOME FORTRAN CODES USED IN THE INITIAL REDUCTION OF DATA TAKEN WITH MULTICHANNEL PULSE-HEIGHT ANALYZERS. J. D. Jarrard and G. T. Chapman (Oak Ridge National Lab., Tenn.). Sept. 16, 1963. Contract [W-7405-eng-26]. 21p.

Three programs written for the IBM-7090 computer and used in the reduction of data taken with multichannel pulse-height analyzers are described. The programs are: PREPARE, which generates the first estimates of a set of Gaussian parameters for use in a nonlinear least-squares fit; BIFIT, which performs a polynomial least-squares fit considering uncertainties in both the x and y coordinates; and ADJUS2, which numerically corrects a measured pulse-height distribution for a gain and/or zero shift of the electronic measuring system. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstracts 11390, 11396, and 11411.

10448 (HW-66921) SPECIFICATIONS FOR ZIRCALOY-4 FUEL JACKET TUBING (REQUISITION G-454778). K. M. Haws (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 28, 1960. Contract AT (45-1)-1350. 6p.

Specifications are presented for the procurement of Zircaloy-4 tubing to be used in the fabrication of swaged UO_2 fuel elements and Pu-bearing fuel elements. The specifications include method of manufacture, material and workmanship, chemical composition and impurities, surface, identity, fluorescent penetrant test, corrosion test, hydrostatic test, pneumatic test, hardness, grain determination, flare test, and swage test. (D.L.C.)

10449 (IITRI-B247-12) IMPROVED PRODUCTION OF POWDER METALLURGY ITEMS. Interim Technical Progress Report, April 1, 1963–June 30, 1963. K. Farrell and N. M. Parikh (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Contract AF33(657)-9140. 30p. (AD-411368; ASD-TDR-7-911(IV))

Results of extrusion tests made on TZM, Inco 713C, Udimet 700, and PH15–7Mo superalloys are described. An assessment of some superalloy powders atomized on a pilot-plant scale is made. TZM and PH15–7Mo can readily be extruded, but some difficulties are encountered with Udimet 700 and Inco 713C, probably because of unsoundness in the cast extrusion billets. The pilot-plant atomized powders are fine, have irregular shape, and low green density, but very high green compact strength and hence good handling properties. Those powders made from prealloyed, high-purity melt stock have acceptable nitrogen contents but high oxygen contents. Powders atomized from argon-melted stock appear to be similar to those made from vacuum-melted stock and considerably less expensive. (auth)

10450 (RFP-356) REDUCTION OF PLUTONIUM COMPOUNDS TO PLUTONIUM METAL. W. V. Conner (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). Feb. 7, 1964. Contract AT(29-1)-1106. 27p.

A survey was made of the literature which was published on the reduction of plutonium compounds to plutonium metal between 1950 and April 1963. This report is a summary of the information which was gathered during the survey. (auth)

10451 (TID-20026) MATERIALS FOR HIGH-TEMPERATURE NUCLEAR ENGINEERING APPLICATIONS. Quarterly Report No. 5, June 1, 1963 to October 1, 1963. J. D. Fleming, J. W. Johnson, Paul Boland, and S. H. Bomar (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract AT(40-1)-2483. 42p.

The results of tensile tests on slip-cast fused silica using a brittle ring test showed that the tensile strength increased roughly linearly from 3100 psi at room temperature to 8100 psi at 2100°F. The activation energies for early cristobalite growth were determined for firing under one atmosphere of air (150 kcal/g mole) and steam (100 kcal/g mole). Etching techniques were studied for phase identification in Al–U_3O_8 dispersions. Etching for 12 hr in a Syntron polisher filled with magnesium oxide slurry removes the aluminum alloy matrix, leaving behind the uranium oxides and aluminum oxide. Steromicrography of the etched specimens reveals the oxide macrostructure. A 0.5% HF solution was found to cause differential staining of the U–Al intermetallic compounds in Al–U_3O_8 dispersions when applied by swabbing for 40 sec. Preliminary electron microprobe analysis results indicated that the 0.5% HF etchant colors UAl_4 blue while UAl_3 is outlined but not colored. ATR Al–U_3O_8 dispersions sag tested under a static pressure differential at 1380, 1710, and 1860°F were examined. In the two lower temperature runs, which produced sag at 0.6 and 0.9 psi respectively, an oxide-free alloy exuded under pressure, producing porosity in the dispersion area. The exuded area was free of uranium oxides and a sharp line of demarcation was apparent between the dispersion and exudate areas. Both areas showed evidence of reaction since a blue-staining was present. The 1860°F test failed to produce sag under an applied stress of 4 psi. No exudation occurred. However, the U_3O_8 was reacted, and UAl_4 and UAl_3 was formed. (N.W.R.)

10452 (TID-20058) A COMPARATIVE STUDY OF ZIRCALOY 2 AND ZIRCALOY 3. (Harvey Aluminum, Torrance, Calif.). [nd]. Contract AT(07-2)-1. 19p. (DPWR-318)

The comparative properties of Zircaloy-2 and Zircaloy-3 ingots were determined at the high and low oxygen levels possible in normal production. The tensile properties were measured at room temperature, 250°C, and 350°C. Corrosion was studied in steam at 750°F and 1500 psi. The corrosion resistance of Zircaloy-3 was found to be low, although it could be increased by thermal treatment. (D.L.C.)

10453 (TID-20069) SINTERING OF THORIA GEL. Technical Report No. XXIII. Alma U. Daniels and Milton E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Jan. 10, 1964. For [Oak Ridge National Lab., Tenn.]. Contract W-7405-eng-26, Subcontract 2176. 20p.

The sintering of samples of solid thoria gel was studied through isothermal measurements made on small pieces of gel approximately 0.25 inches in diameter and 0.10 inches in thickness. The gel was prepared from ORNL's RD 27 steam denitrated thoria through a repetitive sol-gel process and was designated RD 27-2. Measurements were made at approximately 100°C intervals from 600°C to 1000°C using the recording dilatometer system. It was found that before accurate sintering measurements could be made on the gel it was necessary to eliminate shrinkage not due to sintering but due to loss of water and nitrates. Shrinkage due to these effects was eliminated before sintering by preheating the samples at 560°C. Isothermal shrinkage was related to basic sintering theory to yield equations of the form $(\Delta L/L_0) = K^m t^m$. In this study m was found to be 0.31 which is the value derived by Johnson for sintering by grain boundary diffusion. The activation enthalpy was determined using the shrinkages at a given time from the various isotherms and was 41.5 kilocalories per mole. Total linear shrinkage possible appeared to be about 14% with 10% attributable to sintering. Samples fired at 1010°C stopped shrinking after about 200 minutes and approached single crystal density after 1000 minutes. (auth)

10454 (TID-20081) A STUDY OF THE MECHANISM OF STRESS CORROSION CRACKING IN THE IRON–

NICKEL–CHROMIUM ALLOY SYSTEM. Quarterly Report, September 17, 1963–December 16, 1963. F. H. Beck, M. G. Fontana, and J. P. Hirth (Ohio State Univ. Research Foundation, Columbus). Jan. 8, 1964. Contract AT(11-1)-1319. 13p.

A research program for evaluating the susceptibility of single phase iron–chromium–nickel alloys to stress-corrosion cracking in chloride and hydroxide environments is outlined. A schematic description of this program is given for studies of physical metallurgy, electrochemistry, and stress-corrosion cracking susceptibility. The designs of experimental equipment (recirculating autoclave system, small autoclaves, specimen stressing jig, and polarization cell) are shown. Plans for certain areas of experimental work are amplified. (N.W.R.)

10455 (WAL-MS-55) URANIUM: PROPERTIES, PROCESSES, CONTROLS. J. A. Conway and H. F. Campbell (Watertown Arsenal Labs., Mass.). Oct. 1962. 103p.

An account is given of the experiences and practices of Watertown Arsenal on the production, fabrication, handling, utilization, control, and safety of natural or depleted uranium. (D.L.C.)

10456 (EURAEC-733) STUDY OF THE MOLDING AND IRRADIATION OF URANIUM MONOCARBIDE. Quarterly Report No. 10, April 1 to June 30, 1963. J. P. Dumas, B. Mansard, and B. Roger (France. Commissariat à l'Énergie Atomique, Paris). July 10, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 080-62-3RDF. 31p. (A translation)

Irradiation of uranium carbide fuel elements in Melusine and EL-3 is continuing. The fabrication and properties of zirconium carbide rods are discussed. Results are given of electric and thermal conductivity of uranium carbide at 16 to 495°C. The release of xenon-133 from irradiated uranium carbide crystals is evaluated at 1300 to 1600°C. (N.W.R.)

10457 (EURAEC-875) DIFFUSION OF FISSION GASES IN NUCLEAR FUELS. Quarterly Report No. 13, July 1–September 30, 1963. (Hahn-Meitner-Institut für Kernforschung, Berlin). Oct. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 095-62-9 RDD. 20p. (A translation) (EU-B-26)

Diffusion of argon from KCl crystals is reported. The evaporation kinetics of spherical UO_2 crystals is analyzed under a vacuum of 10^{-3} to 10^{-4} torr. The Xe-release from single crystal UC does not follow ideal volume diffusion kinetics. Ideal diffusion behavior is observed with Xe in ThO_2 crystals above 1900°C. The activation energy is 85 kcal/mol between 1400 and 2000°C. (N.W.R.)

10458 (JPRS-22697) SOVIET RESEARCH IN PRODUCTION AND PHYSICAL METALLURGY OF PURE METALS. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, 5-10; 18-33; 47-63; 69-109; 122-48; 160-81; 228-42(May 31, 1963). 164p. (OTS-64-21263)

Thirteen articles are presented which treat respectively the following topics: iodide refining of Zr, corrosion of Zr, scaling of Nb–Zr alloys, Mo single crystals, zone refining of Nb, oxide films on Nb, oxidation of iodide Nb, reaction of Cr–Ni steel with liquid Li, corrosion of Fe and Ti by Li, heat treatment of SAP, mechanical properties of zone-recrystallized Be, and x-ray analysis of radioactive materials. Separate abstracts were prepared for all of the papers. (D.L.C.)

For abstracts of individual papers see: 10347, 10459, 10460, 10461, 10476, 10477, 10478, 10479, 10480, 10481, 10482, 10547, and 10548.

10459 (JPRS-22697(p.1-7)) THE IODIDE METHOD OF REFINING ZIRCONIUM. THE TRANSFER OF NON-METALLIC ADDITIONS DURING REFINING. V. S. Emel'yanov, A. I. Evstyukhin, and D. D. Abanin. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263(p.1-7))

Experiments on the iodide refining of Zr were performed to study the transfer of C, H, N, and O from the starting metal to the refined metal. The results show that 2-fold and 3-fold refining reduces the contents of these elements, but that the reductions are smaller than these of single-fold refining. Further experiments were performed to study the transfer mechanism, and it is concluded that the mechanism proposed by Siefe and Wylie (C_2H_2 and CO are the transfer agents of C and H) is the correct one. (D.L.C.)

10460 (JPRS-22697(p.39-45)) OBTAINING MOLYBDENUM SINGLE CRYSTALS AND THEIR PROPERTIES. V. S. Emel'yanov, A. I. Evstyukhin, G. A. Leont'ev, and A. N. Semenikhin. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263(p.39-45))

A methodology was developed for growing molybdenum single crystals from the gaseous phase using the method of thermal dissociation. Preliminary investigations of hardness, modulus of elasticity, and internal friction were conducted in the single crystals that were obtained. (auth)

10461 (JPRS-22697(p.46-63)) INVESTIGATION OF THE DISTRIBUTION OF ADDITIONS IN NIOBIUM AFTER ZONE REFINING. A. I. Evstyukhin, V. V. Nikishanov, and I. V. Milov. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263(p.46-63))

A brief examination is made of the theoretical assumptions of the possibility and effectiveness of refining niobium of additions by the method of zone recrystallization. The additions in the niobium are classified according to the degree of effectiveness of their refining using zone recrystallization. The experiments that were conducted on zone recrystallization of niobium by the arc method in a copper crucible showed that effective refinement of additions (carbon, iron, lead, and tungsten) with different distribution factors is achieved. It was established that in arc zone recrystallization of niobium there is also refinement of additions by means of vaporization (particularly the volatile additions and also metals that form volatile compounds). (auth)

10462 (OTS-63-11098(Vol.I)) NICKEL AND ITS ALLOYS (VOLUME I). I. I. Kornilov. Translation of "Nikel' i ego Splavy," (a publication of the Publishing House of Academy of Sciences, Moscow, 1958). 352p. (IPST-Cat.-969)

The book discusses the history, uses, development, and future prospects of nickel. Properties of nickel and its compounds are given. The occurrence of nickel in nature, the distribution of its deposits, and nickel metallurgy are described. (D.L.C.)

10463 CESIUM METAL—ITS PRODUCTION AND PURIFICATION. R. J. Moolenaar (Dow Chemical Co., Midland, Mich.). J. Metals, 16: 21-4(Jan. 1964).

The ore resources, properties, and reactions of cesium metal are described. Three methods of ore processing—acid leaching, basic fusion, and direct reduction—are reported. Production of cesium metal by reduction of either

CsBr or CsCl by lithium is detailed. The description of a means for determining the purity of cesium metal is included. (auth)

10464 OUTLOOK FOR MATERIALS IN THE NUCLEAR POWER INDUSTRY. A. N. Holden (General Electric Co., Pleasanton, Calif.). Metals Eng. Quart., 3: No. 4, 39-46 (Nov. 1963).

The materials problems facing the nuclear power industry are related to the industry's two current objectives: the development of reactors with greater power, higher temperatures, and higher flux levels; and, the application of nuclear energy to the exploration of space. The first of these two objectives is confronted by problems with stress-corrosion in superheat applications, strength and size limitations with thick-wall pressure vessels, the effect of radiation of high fast flux, and the effect of high operating temperatures. The problems to be faced in realizing the second objective are considerably greater in number and more difficult. Some of these problems are examined. (auth)

10465 ZIRCONIUM ALLOY TREATMENT PROCESS. K. Anderko, H. Richter, and H. Schleicher (to U. S. Atomic Energy Commission). U. S. Patent 3,121,034. Feb. 11, 1964.

A process of air cooling a zirconium-base alloy subsequent to hot working and prior to cold shaping is described. Steam and hot water corrosion resistance is improved. (AEC)

Corrosion

10466 (AD-404273) DEVELOPMENT OF HIGH-TEMPERATURE ALKALI-METAL-RESISTANT INSULATED WIRE. Quarterly Progress Report No. 1. E. S. Bober, R. E. Stapleton, and W. H. Snavely (Westinghouse Electric Corp., Lima, Ohio). May 15, 1963. Contract AF33(657)-10701. 17p.

The program effort is directed toward the development of an insulated electrical conductor resistant to saturated potassium (850°C) and mercury (538°C) vapors. Surveys of candidate insulators, conductors, and coating methods are substantially completed. Exposure of a number of candidate insulators, uninsulated conductors, and metal-ceramic seals in potassium and mercury vapor was initiated to provide preliminary corrosion data. The mercury vapor exposure tests are completed. Evaluation of a number of coating methods was initiated and preliminary results from the work are promising. (auth)

10467 (AWRE-O-94/63) URANIUM COMPATIBILITY STUDIES. PART 1. THE INTERACTION OF URANIUM WITH GAS-FREE WATER AND WATER VAPOUR. S. Orman (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Dec. 1963. 22p.

The interaction between uranium and both liquid water and water vapor has been studied in the absence of permanent gases in the temperature range 35 to 100°C. The reaction has been shown to proceed at a uniform rate dependent on the temperature and available uranium surface area. The reaction mechanism appears to be unchanged in the temperature range investigated. (auth)

10468 (BMI-X-269) THE CORROSION OF 79-4 (HyMu 80) AND INOR-8 RODS IN ORNL SINGLE VESSEL STUDIES. P. D. Miller, E. F. Stephan, W. K. Boyd, W. N. Stiegelmeyer, and F. W. Fink (Battelle Memorial Inst., Columbus, Ohio). Dec. 27, 1963. Contract W-7405-eng-92. 12p.

Rods of HyMu 80 and INOR-8 were exposed during dissolution-fluorination cycles with HF and F_2 in the molten salt $NaF-LiF-ZrF_4$ at 500°C. Micrometric and metallographic measurements of the corrosion rates were made. The results show that HyMu 80 is more durable than INOR-8 and that corrosion of HyMu 80 is localized. (D.L.C.)

10469 (CONF-187-52) EFFECT OF FLUORIDE IONS ON THE AQUEOUS CORROSION OF ZIRCONIUM ALLOYS. Warren E. Berry (Battelle Memorial Inst., Columbus, Ohio). [1963]. Contract [W-7405-eng-92]. 24p.

From American Nuclear Society Meeting, New York, Nov. 1963.

A review was made of the effects of fluoride ions on the corrosion behavior of zirconium alloys in high-temperature water. Corrosion was found to occur as the result of contamination of the water or the zirconium surface. A major source of fluorides is undue delay in rinsing the $HF-HNO_3$ pickling solution during surface preparation. The oxide on corrosion-resistant material has been found to contain up to 7600 ppm fluoride from this source. The threshold concentration of fluoride in the oxide film which produces poor corrosion resistance ranges from 8500 to 17,000 ppm. Accelerated corrosion from fluorides in water at 300 to 360°C occurs at about 100 ppm, although increased corrosion has been reported at 10 ppm fluoride in water at 300°C. Fluorocarbon plastics degrade and contribute fluorides to the high-temperature water or to the alloy surface when in direct contact with zirconium. Chlorides (1 to 10,000 ppm) and iodides (1270 ppm) do not adversely affect the corrosion behavior of zirconium alloys in water at 360°C. The mechanism of corrosion is not well understood but apparently is related to the formation of insoluble zirconium oxyfluorides during pickling and during exposure to fluoride-contaminated water. (auth)

10470 (EURAEC-812) IN-PILE CORROSION OF NUCLEAR MATERIALS. Quarterly Report No. 5, April 1–June 30, 1963. (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium). Work Performed under United States–Euratom Joint Research and Development Program. Contract 084-62-3-RDB. 30p.

Several loops were introduced into the Belgian Reactor-1. Potentiodynamic measurements were made on Pt electrodes in solutions of NH_4NO_3, $(NH_4)_2HPO_4$, $NH_4NO_3 + (NH_4)_2HPO_4$, $KHCO_3$, NH_4OH, KOH, and HNO_3 saturated with air and with nitrogen, and on boiler-plate steel CSX in a solution of KOH pH 11 saturated with nitrogen. Radiation effects on platinum are tentatively explained by assuming that pile irradiation changes the absorption capacity of platinum. Oxygen and pH also affected absorption. While operating the permanent loop, difficulties were encountered as to cooling, activation of specimen insertion rod, and electrical insulation. Niobium, titanium, and tantalum specimens were investigated by means of the single pulse method. The relation between capacitance, pulse overpotential, and current density for these metals was similar to that found for zirconium. The relation between pulse overpotential and logarithm of the current density for anodically oxidized zirconium and tantalum was nonlinear in some cases. Irradiation of zirconium in pure argon gave differences in the results of the electrochemical measurements. Some doubt still exists about the value of the results on irradiated zirconium and titanium in oxygen atmosphere. (auth)

10471 (HW-67437) HYDROGEN PICKUP OF ZIRCALOY-2 AND ZIRCALOY-4 IN STATIC VS REFRESHED AUTOCLAVING SYSTEMS. Interim Report. H. P. Maffei and D. W. Shannon (General Electric Co.

Hanford Atomic Products Operation, Richland, Wash.). Nov. 10, 1960. Contract AT(45-1)-1350. 15p.

The amount of corrosion product hydrogen pickup in 400°C, 1500 psi steam for Zircaloy-2 and Zircaloy-4 is higher in a static autoclave than in a refreshed autoclave system by a factor of approximately two. The hydrogen pickup averaged 26% in the static system as compared to 13% in the refreshed system. The data presented appear to show either that the zirconium alloys tested are sensitive to hydrogen overpressures existing in static autoclave systems or that the higher oxygen concentration in the refreshed system is affecting the mechanism of hydrogen pickup. The corrosion rates of Zircaloy-2 and Zircaloy-4 in 400°C, 1500 psi steam were very similar. However, two of the four lots of Zircaloy-4 show premature breakaway, probably due to poor-quality material. One lot of Zircaloy-2 showed normal corrosion weight gains in the static system, but a premature breakaway in the refreshed. An acceptable explanation for this has not yet been found. There are several implications of the data. First, hydrogen pickup of Zircaloy during testing of reactor components can be reduced by operating in a refreshed autoclave. Second, since it was shown environmental conditions had an effect on hydrogen pickup, it may be possible to control H_2 pickup in reactor systems by environment control. (auth)

10472 (MSAR-64-6) EFFECT OF HIGH-TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS. Progress Report 40, December 1963. (MSA Research Corp., Callery, Penna.). Jan. 21, 1964. Contract AT(11-1)-765, Mod. 1. 40p.

A research program is being conducted to determine the effects of high-temperature reactor-grade sodium and contaminants (O, C, N) on the tensile, creep, creep-to-rupture, and fatigue properties of Type 316 stainless steel and 2¼ Cr–1 Mo steel. Tests 1 (stainless steel in 1200°F low-oxygen sodium, air, and helium) and 2 (2¼ Cr–1 Mo steel in 1100°F low-oxygen sodium, air, and helium) were completed. Test 3 (stainless steel in 1200°F high-carbon sodium) was delayed. In Test 4 (2¼ Cr–1 Mo steel in 1100°F high-oxygen sodium), the creep rupture tests show a shorter life of both the original and exposed specimens in sodium with 300 ppm oxygen than with 30 ppm oxygen; the fatigue life was the same in sodium with 300 and 30 ppm oxygen; and the creep rate in sodium with 300 ppm oxygen was lower than with 30 ppm oxygen but still higher than in air or helium. (D.L.C.)

10473 (ORNL-TM-746) STABILITY OF THERMOELECTRIC MATERIALS IN A HELIUM–GRAPHITE ENVIRONMENT. R. L. Bennett, H. L. Hemphill, W. T. Rainey, Jr., and G. W. Keilholtz (Oak Ridge National Lab., Tenn.). Jan. 10, 1964. Contract [W-7405-eng-26]. 7p.

Twenty-five metals were tested for thermoelectric stability in helium containing 500 ppm H_2 and 500 ppm CO over graphite. Metals exhibiting 2% or less error in their output against platinum at 420°C after exposure for 141 days at 982°C were Chromel-P, Special Chromel-P, Ni-18Mo, Geminol-N, and Special Alumel. (auth)

10474 (X64-11364) POTASSIUM CORROSION TEST LOOP DEVELOPMENT. Quarterly Progress Report 1, July 15, 1963 through October 15, 1963. E. E. Hoffman, ed. (General Electric Co. Spacecraft Dept., Cincinnati). Contract NAS 3-2547. 26p.

The design and development of a prototype corrosion test loop for the evaluation of refractory alloys in boiling and condensing potassium environments which simulate projected space electric power systems are reported. The envisioned prototype test consists of a two-loop Nb–Zr alloy facility; sodium will be heated by direct resistance in a primary loop and will be used in a heat exchanger to boil potassium in the secondary corrosion test loop. Heat rejection for condensation in the secondary loop will be accomplished by radiation in a high vacuum environment. The development program is proceeding with the design, construction, and testing of three test loops, each of which will be used in a sequence of component evaluation and endurance testing. The design of Loop I, the natural convection sodium loop, is completed. The design of Loop II, a forced circulation sodium loop, is underway. The pre-prototype corrosion test loop, a two-loop system, is being designed. The design and development of the helium analysis system, helium purification system, and hot trap systems for purifying sodium and potassium are summarized. (N.W.R.)

10475 (EURAEC-864) STUDIES OF STEEL CORROSION IN HIGH-TEMPERATURE WATER AND STEAM. Quarterly Report No. 5, July 1–September 30, 1963. (Société d'Etudes, de Recherches et d'Applications pour l'Industrie, Brussels). Oct. 28, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 089-62-7RDB. 87p. (A translation)

Progress is reported on the study of corrosion of Creusot 1.2 MD07 boilerplate steel and type 304 stainless steel by steam at 300 and 400°C and water at 300°C. Theoretical and experimental analysis is made of the effects of temperature, time, surface conditions, metal composition, oxidation, heat treatment, passivation, coolant state, work-hardening, electrolytic polishing, and hydrogen diffusion. The development of the dynamic corrosion test loop is summarized. (N.W.R.)

10476 (JPRS-22697(p.8-26)) THE EFFECT OF HYDROGEN AND NITROGEN ON THE CORROSION RESISTANCE OF ZIRCONIUM IN WATER AND STEAM. V. N. Emel'yanov and N. V. Borkov. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263(p.8-26)) •

It was shown that it is possible using the equipment and methodology described to obtain zirconium specimens with different preassigned hydrogen contents. It was also shown that an increase in the hydrogen content in the zirconium specimens reduces its corrosion resistance in a steam atmosphere. The corrosion resistance of zirconium is sharply reduced with an increase in the nitrogen content in it. In an atmosphere of superheated steam at t = 400° and p = 280 atmospheres, zirconium containing 0.007 wt % nitrogen and more is not a corrosion-resistant material since even with a nitrogen content of 0.007 wt % specimens did not withstand tests lasting more than 100 hours. In a steam atmosphere at t = 350° and p = 170 atmospheres, zirconium containing 0.007 wt % nitrogen and more also is not a corrosion-resistant material although the testing time for specimens containing 0.007 wt % nitrogen was somewhat increased. In a steam atmosphere at t = 300° and p = 88 atmospheres, the corrosion resistance of zirconium with small additions of nitrogen is considerably higher: specimens with 0.015 wt % nitrogen withstood tests lasting 1000 hours and specimens with 0.007 wt % nitrogen lasted 4000 hours. Nitrogen reduces corrosion resistance much more than hydrogen. (auth)

10477 (JPRS-22697(p.27-38)) THE FORMATION OF SCALE WITH A STRUCTURE $6ZrO_2 \cdot Nb_2O_5$ ON ALLOYS OF ZIRCONIUM WITH NIOBIUM. Yu. F. Bychkov, V. A. Ivanov, and A. N. Rozanov. Translation of Met. i Metal-

loved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263(p.27-38))

It was shown that upon oxidation in air of alloys Zr–25% Nb and Zr–15% Nb–10% Mo, a compound $6ZrO_2 \cdot Nb_2O_5$ appears on the surface along with ZrO_2. The amount of the $6ZrO_2 \cdot Nb_2O_5$ during strong oxidation at 1200°C of alloy Zr–25% Nb reaches almost 100% and close to 100% for the second alloy. Preliminary oxidation of these alloys at 1200°C at lowered pressure in oxygen and in air before the formation of the black oxide film somewhat increases their resistance to oxidation at 700°C which is not due, however, to the formation of $6ZrO_2 \cdot Nb_2O_5$. The elevated resistance to oxidation of alloy Zr–25% Nb at temperatures below 600°C, evidently, cannot be explained only by the formation of the compound $6ZrO_2 \cdot Nb_2O_5$ since even after oxidation at 600°C the content of this compound in the oxide film is low. (auth)

10478 (JPRS-22697(p.64-78)) ELECTRON DIFFRACTION AND X-RAY PHOTOGRAPHIC INVESTIGATION OF OXIDE FILMS ON NIOBIUM. I. I. Korobkov, B. N. Revyakin, and Khe-min Chen'. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263(p.64-78))

Electron diffraction and x-ray photographic investigation of the phase composition of oxides on niobium in contact with metal and flaked off of it after oxidation in oxygen (150 mm of mercury) in the temperature range 400 to 1100°C was conducted. As a result, it was established that: (1) The structure of oxide films firmly bonded to the metal, in relation to the temperature, more or less is different from niobium oxides that have already flaked off the specimen. (2) In the temperature range 700 to 900°C a mixture of the phases alpha'–Nb_2O_5 and beta'–Nb_2O_5 is observed in these oxide films. As the temperature is raised the amount of the phase alpha'–Nb_2O_5 is reduced and the amount of beta'–Nb_2O_5 is increased. (auth)

10479 (JPRS-22697(p.79-96)) INVESTIGATION OF THE KINETICS OF THE OXIDATION OF IODIDE NIOBIUM REFINED BY THE ELECTRON-BEAM METHOD. I. I. Korobkov, B. N. Revyakin, and Khe-min Chen'. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263 (p.79-96))

The kinetics of oxidation of iodide niobium remelted in an electron beam in oxygen at 350 to 1200°C was studied by the method of continuous weighing. As a result it was established: (1) In the temperature range 350 to 400°C, the oxidation process in the initial period is described by a parabolic law and then there is a transitional stage which is characterized by an increase in the oxidation rate. (2) The established process of niobium oxidation in all of the temperature ranges that were studied corresponds to the linear law. (3) In the temperature relation of the constants of the rate of the linear law of oxidation there are three temperature ranges (600–612°C, 900–950°C, and 1000–1100°C) in which the oxidation rate is reduced with an increase in temperature. (4) The anomaly in the temperature relation of the constant of the oxidation rate of niobium in the temperature range 600 to 612°C is associated with the sharp increase in the thickness of the dark oxide sublayer. (5) The oxidation rate of niobium according to the linear law increases with an increase in oxygen pressure while the oxygen pressure has no noticeable effect on the rate of the process described by the parabolic law. (auth)

10480 (JPRS-22697(p.97-105)) REACTION OF AUSTENITE CHROMIUM–NICKEL STEEL WITH LIQUID LITHIUM. N. M. Beskorovaynii, M. T. Zuev, and V. S. Eremeev. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263(p.97-105))

After testing 1Kh18N9T steel in lithium contained in vessels made of the same steel at 1000 and 1200°C, no significant changes of mechanical properties of steel are observed in comparison with identical treatment in argon medium. In accordance with these indications, 1Kh18N9T steel possesses sufficient corrosion resistance in lithium at 1000 and 1200°C for a period of 100 hours. No significant corrosion effects of lithium on welding seams of 1Kh18N9T steel were found. The rate of corrosion of 1Kh18N9T steel is calculated from weight losses of specimens (apparently associated with leaching out of chromium and nickel) at 1000°C comprises 0.034 $g/m^2 \cdot hr$, and at 1200°C 0.388 $g/m^2 \cdot hr$. During testing of 1Kh18N9T steel in reaction vessels made of technical iron, lithium diffuses into the surface layer of steel to a significant depth, which may aid the development of intercrystalline corrosion. (auth)

10481 (JPRS-22697(p.106-17)) CORROSION RESISTANCE OF IRON IN LITHIUM. N. M. Beskorovaynii, V. S. Eremeev, M. T. Zuev, V. K. Ivanov, and Yu. Ya. Tomashpo'skii. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263(p.106-17))

During testing of iron in lithium, its surface becomes coarse and dissolution proceeds predominantly along the grain boundaries. Due to the refining effect of lithium, the strength is lowered and plasticity of the surface layer of iron is increased. Diffusion of lithium in iron proceeds along the grain boundaries and boundaries of substructure and is directly related to contamination of boundaries with impurities of carbon, sulfur, etc., to which lithium has a significant chemical affinity. The interaction of lithium with the indicated impurities causes intercrystalline corrosion. In vacuum-fused as well as industrial iron, the diffusion mobility of lithium as a function of temperature is evaluated by quantities which are given. To improve the stability of structural materials in lithium it is necessary to direct particular attention to the technology of their production—use of vacuum fusion and other methods which aid in obtaining purer metals and alloys with respect to gaseous and other impurities. (auth)

10482 (JPRS-22697(p.118-23)) CORROSION RESISTANCE OF TITANIUM IN LITHIUM. N. M. Beskorovaynii and M. T. Zuev. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263(p.118-23))

Technical titanium and Ti + Al alloy have satisfactory stability in lithium at 800°C in the course of 100 hours. During testing of titanium in lithium, the former absorbs dissolved gases causing formation of surface films of increased hardness and lowering of plasticity after testing at 1000 and 1200°C. At 1200°C, significant dissolution of titanium occurs. In the Ti + Al alloy in connection with the presence of aluminum, dissolution processes are developed in the 800 to 1200°C range. The change of composition causes drastic lowering of the strength and of plasticity after testing at 1000 and 1200°C. The welding seam of Ti + Al alloy behaves in lithium analogously to the alloy itself. (auth)

10483 THE EFFECT OF CERTAIN GASES ON THE RATE OF OXIDATION OF URANIUM BY WATER VAPOUR. S. Orman (Atomic Weapons Research Establishment, Alder-

maston, Berks, Eng.). Chem. Ind. (London), No. 42, 1692-3 (Oct. 19, 1963).

The effects of hydrogen, oxygen, and nitrogen on the oxidation of uranium by water vapor (233 mm at 70°C) were studied. With degassed water vapor the uranium oxidized at a uniform rate dependent on temperature and surface area of exposed metal. The corrosion product was identified as a nonstoichiometric (oxygen-rich) uranium dioxide. The addition of either hydrogen or nitrogen had no effect on either the rate of the reaction or the products. The addition of oxygen to the water vapor caused a marked decrease in corrosion rate, but this retardation was effective for only a finite period, the length of which was dependent on the initial gas pressure introduced and the temperature of reaction. (M.C.G.)

10484 SOME IMPEDANCE MEASUREMENTS OF ANODIC FILMS FORMED ON TANTALUM AND NIOBIUM IN SULPHURIC ACID. P. H. G. Draper (Imperial Coll. of Science and Tech., London). Electrochim. Acta, 8: 847-55 (Nov. 1963).

The variations of the equivalent parallel resistance and capacitance of anodic films formed on Ta and Nb in varying concentrations of H_2SO_4 suggested that the volume of film formed per coulomb is much greater in 100% acid, although the dielectric constant is substantially unchanged. The field required for growth on Ta in 100% acid is about 85% of that in aqueous solutions, where it is constant up to about 60% H_2SO_4. Slow conversion of films formed in 100% acid occurs when they are immersed in dilute H_2SO_4; this change is very rapid when charge is passed. Virtually no change occurs in the converse case, indicating that the change in film properties found during growth in 100% acid is a characteristic of the growth process. Marked corrosion or dissolution of the film material in 100% H_2SO_4 is apparent with Ta at temperatures above 50°C, and for Nb above 25°C. The similarity of the behavior of the loss factor, tan δ, with both metals, as the film thickness is increased, suggests that areas of high loss, but not of low dielectric constant, arise by the trapping of solution, and that these exert a predominating influence. (auth)

10485 THE INVESTIGATION OF PASSIVATING OXIDE LAYERS ON ZIRCONIUM METAL USING SMALL SINGLE SHOT ANODIC CURRENT PULSES. P. Weisgerber (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). Electrochim. Acta, 8: 937-47(Dec. 1963).

Passivated metals such as Al, Nb, Ta, and particularly Zr were anodically polarized in aqueous sulfate solution by single-shot intensiostatic charge pulses, and the overtensions recorded on photograms. The initial slope of the overtension/time curves is given by the capacitance of the passivating oxide film. The slope decreases when, with rising electrical field strength across the oxide film, the ionic current flow increases. In agreement with the known theories (Wagner; Mott; Verwey et al.) a straight line results, from plots of the overtension measured at charge densities of 10^{-4} coulomb/cm^2 vs. the logarithm of the current density. From the slope of this straight line the thickness of the passivating layer can be obtained without interference of the surfaces's roughness. For the measurement of the thickness of the passivating oxide film of an individual specimen surface, two successive pulses were applied, the first of 3.3×10^{-5} amp/cm^2 and the second of 3.3×10^{-3} amp/cm^2 current density; the pulse duration was so chosen that each pulse represented the same charge density, 10^{-4} coulomb/cm^2. Thus the modifications of the original surface state of the electrode metal caused by each pulse were negligible. From the difference of the maximum overtensions and the difference of the logarithms of the current densities of the two pulses the thickness of the passivating oxide film of the investigated sample can be calculated. The method was checked measuring zirconium samples after gravimetrically controlled oxidation. The results obtained by applying the method to differently prepared metal surfaces are discussed. (auth)

10486 ELECTROLYTIC FORMATION OF INSULATING OXIDE FILMS ON ZIRCONIUM. I. CURRENT EFFICIENCY AND FORMATION FIELD AT CONSTANT CURRENT. G. C. Willis, Jr., G. B. Adams, and P. Van Rysselberghe (Univ. of Oregon, Eugene). Electrochim. Acta, 9: 79-91(Jan. 1964).

With chemically polished electrode surfaces ionic current efficiencies and formation fields were measured for the anodic oxidation of iodide-process zirconium at constant current over a temperature range of 6.5 to 65°C and over a thousand-fold range of current densities. Ionic current efficiencies ranged from 0.40 to 1.0, and were found to approach unity (for oxide films formed at voltages above 40 v) at the lowest temperatures and highest current densities. A color-thickness comparison gage was prepared and used in film thickness measurements. Gage calibration was made directly in the region of 80 v by weight increase measurements, and indirectly at other voltages by capacitance measurements. Film thickness estimates were then made by using a technique which combined color comparisons with capacitance measurements. (auth)

10487 ELECTROLYTIC FORMATION OF INSULATING OXIDE FILMS ON ZIRCONIUM. II. ELECTRODE KINETICS AT CONSTANT VOLTAGE. G. C. Willis, Jr., G. B. Adams, and P. Van Rysselberghe (Univ. of Oregon, Eugene). Electrochim. Acta, 9: 93-101(Jan. 1964).

The kinetics of formation of insulating oxide films on zirconium was studied working at a constant voltage of 72.9 v. The results obtained were used to test two theoretical expressions for metal-oxide film formation kinetics. A value of 1.24 ev was obtained for the interfacial barrier height using the Mott-Cabrera theory and assuming a fixed half-jump distance of 2.5 Å and a limiting, saturation value for the concentration of active sites for oxide growth at the metal surface. With the Dewald theory, values of 1.58 and 1.73 ev were obtained for the interfacial and internal barrier heights, respectively, and 2.9 and 4.6 Å for the corresponding half-jump distances. Some evidence is presented for variation of the concentration of metal surface active sites with film formation rate. (auth)

10488 OXIDATION OF Ni–2ThO_2 BETWEEN 900° AND 1400°C. Frederick S. Pettit and Edward J. Felten (Pratt and Whitney Aircraft, North Haven, Conn.). J. Electrochem. Soc., 111: 135-9(Feb. 1964).

The oxidation kinetics of nickel containing 2 vol % ThO_2 were studied between 900 and 1400°C. In this temperature range the oxidation rate obeys the relationship $\Delta M/A = k^{0.50}t^{0.56}$. Metallographic examination of oxidized Ni–2ThO_2 specimens showed the oxide to be composed of a dense outer layer and a porous inner layer. Inert α-Al_2O_3 markers were found at the boundary between the dense and porous oxide layers. Internal oxidation was also apparent but not to the extent found in pure nickel. X-ray fluorescence analysis showed ThO_2 to be absent in the dense outer oxide but present in the porous inner oxide. Oxidation of Ni–ThO_2 is believed to occur primarily by means of nickel ion diffusion to produce the outer oxide layer and diffusion of oxygen gas to form the inner oxide layer. The oxygen gas required to form the inner oxide layer is produced by de-

composition of NiO in the outer oxide layer at the boundary between the inner and outer oxide. (auth)

10489 HIGH-TEMPERATURE OXIDATION OF ZIRCONIUM AND ZIRCALOY-2 IN OXYGEN AND WATER VAPOR. R. E. Westerman (General Electric Co., Richland, Wash.). J. Electrochem. Soc., 111: 140-7(Feb. 1964).

Zirconium and Zircaloy-2 were found to gain more weight in oxygen than in water vapor at low pressures. The pretransition oxidation kinetics of Zircaloy-2 are comparable with those of pure zirconium, both following a cubic rate law. The pretransition oxidation kinetics of Zircaloy-2 are sensitive to water vapor pressure in the range of 5–25 mm, but are not sensitive to oxygen pressure. The post-transition oxidation kinetics of Zircaloy-2 are notably dependent on the pressure of either gas, indicating a gaseous diffusion rate control. Zirconium exhibited no transition in rate from the cubic over the duration of the exposure. It is shown that the rate-controlling mechanism that results in the cubic rate law is not directly dependent on the total thickness of the oxide layer. Activation energies for the rate-controlling mechanism of the cubic rate law lie in the range 50–63 kcal/mole, indicating that similar mechanisms are operative, regardless of material or atmosphere. (auth)

10490 OPTICAL PROPERTIES OF ANODIC-OXIDE INTERFERENCE FILMS ON URANIUM IMMERSED IN REFRACTIVE MEDIA. W. P. Ellis and E. D. Megarity (Los Alamos Scientific Lab., N. Mex.). J. Opt. Soc. Am., 54: 225-8(Feb. 1964).

The spectrophotometry of anodically formed oxide films on uranium metal immersed in refractive media is discussed in terms of the vector addition of the wave components. Immersion alters the optics by decreasing the amplitude of the wave vector reflected at the medium-film interface. Diminution of the transmitted wave vector through absorption by the film in the near ultraviolet also has a decisive effect upon the wavelength dependence of the optics on immersion. By means of immersion spectrophotometry, the relative magnitudes of the component wave vectors were determined, the refractive index of the film was obtained by extrapolation to zero interference, and the extinction coefficient was determined as a function of wavelength. (auth)

10491 CURRENT DEVELOPMENTS IN COATED REFRACTORY METALS AND ALLOYS. James J. Gangler (National Aeronautics and Space Agency, Washington, D. C.). Metals Eng. Quart., 3: No. 3, 39-44(Aug. 1963).

The need for oxidation-resistant refractory metal sheet structures for hypersonic and re-entry vehicles resulted in some significant advances in coatings for molybdenum, niobium, tantalum, and tungsten. Manufacturing methods for large silicide-coated molybdenum parts are under development. Silicide coatings for niobium are being optimized for reliability and reproducibility. Silicides, but particularly aluminide coatings, appear promising for protecting tantalum. Silicide coatings were investigated for tungsten. Standardized testing procedures are under study, which, upon adoption, will advance the development of coatings. (auth)

10492 TITANIUM AND TITANIUM ALLOYS IN MERCURY—SOME OBSERVATIONS ON CORROSION AND INHIBITION. James Y. N. Wang (Argonne National Lab., Ill.). Nucl. Sci. Eng., 18: 18-30(Jan. 1964).

Titanium and titanium alloys are not generally resistant to mercury in the temperature range between 371 to 538°C. The extent of corrosion is dependent upon alloy composition and heat treatment. Nitrided surfaces of titanium and its alloys exhibit high resistance to mercury at 538°C for periods up to 14 days. At this temperature, mercury vapor attacks certain nitrided alloys while others are immune. For instance, the corrosion of a nitrided Ti/8 wt % alloy was found to be insignificant; however, severe corrosion occurs at the nitrided layer of Ti/7 wt % Al/12 wt % Zr. A study of the effect of metallic additives to mercury on the corrosion resistance of titanium at 538°C was also made. It was shown that a saturated mercury solution of zirconium or nickel exerts a strong influence in reducing corrosion. The films formed may act as a diffusion barrier between solid and liquid. (auth)

10493 OXIDATION OF GRAPHITE, MOLYBDENUM AND TUNGSTEN AT 1000 TO 1600°C. E. A. Gulbransen, K. F. Andrew, and F. A. Brassart (Westinghouse Research Labs., Pittsburgh). New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-493, 10p. $1.00. (CONF-391-3)

From AIAA Heterogeneous Combustion Conference, Palm Beach, Fla., Dec. 1963.

Weight change and oxygen consumptions methods were used to determine the rates of oxidation in static and dynamic reaction systems. Gas diffusion effects were eliminated by the use of small samples or fast flow rates. Very fast rates of oxidation were found. The kinetic data could be fitted in the chemical controlled region of oxidation by a model based on mobile oxygen adsorption. The data also are discussed in terms of kinetic theory. (auth)

Fabrication

10494 (AD-427700(p.245-80)) REFRACTORY METAL SANDWICH STRUCTURES FOR AEROSPACE APPLICATIONS. J. W. McCown and A. M. Norton (Martin-Marietta Corp. Aerospace Div., Baltimore).

Procedures were developed for fabricating brazed honeycomb sandwich panels of D-36 (Nb–10Ti–5Zr) niobium and TZM (Mo–0.5Ti–0.07Zr) molybdenum. Two types of panels simulating different aerospace vehicle applications were fabricated and tested; one represents a load-carrying structural application for utilization as monocoque or semi-monocoque structure, and the other is a modular-radiant-heat-shield panel for a double-walled structural concept. The D-36 niobium structural panels were tested to 2400°F and demonstrated excellent structural integrity and strength. The heat-shield panels were tested in a dynamic hot-gas environment at temperatures to 2600°F. Several state-of-the-art improvements were made in the fields of forming, welding, brazing, and testing. (auth)

10495 (MATT-228) A 19-INCH DIAMETER BAKEABLE METAL–CERAMIC SEAL. K. F. Kirchner (Princeton Univ., N. J. Plasma Physics Lab.). Oct. 1963. Contract AT(30-1)-1238. 22p. (CONF-209-20)

From American Vacuum Society Meeting, Boston, Oct. 1963.

The hydride brazing process used for making a bakeable ceramic–metal assembly of 19 inches diameter and 42 inches long necessitated a re-examination of allowable thermal stresses, heating rate of the ceramic as well as a vacuum furnace for 1000°C and 700 liter volume. Mass spectrometer determinations were made of partial pressures above 350°C during brazing cycle, when the titanium exists in a highly reactive state. The troublesome outgassing of internal heat reflectors, needed to prevent excessive temperature gradients in the ceramic, was avoided through judicious use of auxiliary external heaters rather than using exceedingly high pumping speeds. (auth)

10496 (NMI-TJ-55) THE HOT EXTRUSION OF UO_2 FUEL ELEMENTS. J. Hunt and P. Loewenstein (Nuclear Metals, Inc., West Concord, Mass.). Nov. 25, 1963. Contract [AT(30-1)-1565]. 18p. (CONF-388-1)

From 64th Annual Meeting of the American Ceramic Society, New York, May 1962.

A hot extrusion technique for stainless steel-clad UO_2 fuel elements was developed that utilizes the fact that uranium dioxide can be hot extruded in a manner analogous to metals. The process, based on the multitemperature coextrusion technique previously used for metallic nuclear fuel elements, involves the coextrusion of UO_2 at 1875°C within the cladding at 760°C. The principles employed, the process development, and a product description are discussed. (auth)

10497 (RTD-TDR-63-4236) THE DEVELOPMENT OF OPTIMUM MANUFACTURING METHODS FOR COLUMBIUM ALLOY SHEET. James S. Clark, Albert L. Mincher, and George N. Villee (Du Pont de Nemours (E. I.) & Co. Metals Center, Baltimore). Dec. 20, 1963. Contract AF33(600)-39942. 70p. (AD-427333)

A description is given of the development of a manufacturing process for D-43 Nb alloy sheet (Nb–10W–1Zr–0.1C, formerly called X-110). Six thousand pounds of second-melt electrodes were melted into eight-inch diameter ingots. The ingots were converted by extrusion and rolled to twenty-four inch wide sheets in three gages, 0.012, 0.018, and 0.030 inch. The material was dispersion-strengthened by solution treatment at penultimate gage and aging at final gage. Sheets of all three gages had consistently high tensile strength at elevated temperature. The sheet processing is described. Sheet quality was emphasized. The gage control was excellent, the majority of sheets being within one-half of the standard tolerances. The results of the quality control inspection are given. Various mechanical and physical properties of final product sheet are also given. (auth)

10498 (TID-20047) ZIRCONIUM — SUMMARY REPORT ON DEVELOPMENT OF 3" DIAMETER HOUSING TUBE WITH INTERNAL STRAIGHT RIBS. R. B. Simonson (Harvey Aluminum, Torrance, Calif.). [nd]. Contract AT(07-2)-1. 26p.

Techniques were developed for the hot extrusion of thin-walled, 3-inch-diameter, Zircaloy-4 housing tubes with four internal ribs. The as-extruded tubes were corrosion resistant and met specified dimensions. Close tolerance dimensional reproducibility was demonstrated in the extrusion of a number of tubes. (auth)

10499 (TID-20048) ZIRCONIUM — SUMMARY REPORT ON DEVELOPMENT OF 4" DIAMETER HOUSING TUBES WITH INTERNAL STRAIGHT RIBS. R. B. Simonson (Harvey Aluminum, Torrance, Calif.). May 1961. Contract AT(07-2)-1. 23p.

Extrusion techniques were developed for the production of a relatively large diameter, thin walled, housing tube, with four internal straight ribs. Several tubes were produced, in Zircaloy-2 alloy, which met the objectives of the program with the exception of a light inverted cusp opposite the rib areas on the outside wall. (auth)

10500 (EURAEC-739) STUDY OF RESIDUAL STRESSES CAUSED BY THE VERTICAL ASCENDING WELD PROGRESS. Quarterly Report No. 6, April 1–June 30, 1963. (ARCOS, S. A. Brussels). Work Performed under United States — Euratom Joint Research and Development Program. Contract 053-61-12-RDB. 48p. (A translation).

Testing of test bar No. 9 was continued by the determination of surface stresses, measurement of penetration, measurement of temperatures, and determination of the exact position of the couples. The development of the method using strain gages for measuring stresses in depth was completed. Complementary verification tests for the temperature measurement method using the system where couples are welded on metal rods or cores inserted in the measurement apertures are reported. (N.W.R.)

10501 (EURAEC-787) WELDING OF VERY THICK STEEL. Quarterly Report No. 7, April 1 to June 30, 1963. (Ghent, Rijksuniversiteit and Soudometal, S. A., Brussels). Work Performed under United States–Euratom Joint Research and Development Program. Contract 042-61-9-RDB. 144p. (A translation)

Progress made in the development of welding techniques for very thick steel is described. Topics covered include: chemical analysis at various levels in 100-mm-thick welded joints; mechanical properties of 100-mm-thick joints welded automatically by magnetic and submerged-arc welding processes; transformation zones of steels 13 C and 23 A welded automatically under artificially cooled conditions; mechanical properties of the metal deposited at right angles to the notches already present in the basic metal; embrittlement and restoration of the basic steels 13 C and 17 C; global bend testing of steel 17 C (100 mm thick); global bend testing of rods taken crosswise in the 100 mm thick manually welded joints; properties of steels A and C; and metallography. (N.W.R.)

10502 (EURAEC-788) URANIUM OXIDE EXTRUSION. Final Report. J. Mercier (Compagnie Industrielle des Combustibles Atomiques Frittes, Corbeville, par Orsay (Seine-et-Oise), France)). July 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 070-62-5 RDF. 54p. (A translation)

Fifteen powders of different origins and qualities were extruded into rods having densities from 9.9 to 10.7 g/cm^3. Since the extrusion and sintering conditions were the same, the density differences are due to powder quality. The vertical extrusion tests undertaken have shown that rods can be extruded either on a horizontal press or on a vertical press. These results are of interest from an economic point of view. Tests using the Werner mixer are not conclusive. An appreciable improvement in the extrusion process was made by recovering waste representing 10 to 15% of the starting materials. (N.W.R.)

10503 (EURAEC-813) SECOND REPORT OF CONCLUSIONS AND HYPOTHESES. General Outline of the Results Obtained from September 1, 1962–August 31, 1963 and the Arrangements Made for Executing Global Bend Tests. Special Report No. 6. (Ghent, Universiteit and Soudometal, S. A., Brussels). Work Performed under United States–Euratom Joint Research and Development Program. Contract 042-61-9 RDB. 58p. (A translation).

Results relative to the tests on basic steel, examination of heat affected zones, tenso-thermal embrittlement tests on basic steel and pre-notched joints, and tests carried out on filler metals are summarized. Arrangements made and programs proposed for the execution of semi-global and global bend tests along with Robertson and tensile tests on plates containing faults existing prior to welding are presented and justified. (N.W.R.)

10504 (EURAEC-849) ELECTRO-SLAG-WELDING OF REACTOR STEELS. Quarterly Report No. 10, July 1–September 30, 1963. (Schweisstechnische Lehr- und

Versuchanstalt, Duisburg, Germany). Oct. 24, 1963. Work Performed under United States–Euratom Joint Research and Development Program. 146p. (A translation)

Development and testing of electroslag welding techniques for reactor steels are reported. Information is included on: composition of welding rods and powder additives; tensile tests; models for circular seam welding; joint welding; welding data; oxygen content of welded materials; notch impact-bending tests on Charpy-V-notch and DVM samples; composition of reactor steels used in these tests; metallography; and currents and polarities of the welding rods. The steels used in the tests are: ASTM 302 Grade B, HOAG Wel-Monix, and chromium–molybdenum steels. The effects of annealing on welding techniques are evaluated. A bibliography is included containing abstracts of 120 references arranged chronologically from 1955 with each year's abstracts listed alphabetically by author. Most of the references on electroslag welding techniques are taken from Russian literature. (N.W.R.)

10505 (EURAEC-853) METHODS EMPLOYED IN THE FABRICATION OF PRESSURE VESSELS. Quarterly Report No. 7, July 1 to September 30, 1963. (Neratoom, N. V., The Hague). Oct. 24, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 069-61-12-RDN. 61p. (A translation)

The mechanical properties of three weld seams obtained by submerged-arc welding using a single welding head are evaluated. The faults are compared using destructive and ultrasonic testing techniques. In regard to arc welding with a double welding head, the difficulties caused by the accumulation of solidifying slag between the electrodes are solved by increasing the speed. Welding conditions for a third welded seam are given. Results are included of the destructive and nondestructive tests. Results are also included of destructive tests of welds made by welding under carbon dioxide shielding. Mechanical tests of welds made by welding in enclosed carbon dioxide shielding are evaluated. (N.W.R.)

10506 SINTERING ALUMINA–URANIA COMPOSITIONS. I. Amato, R. L. Colombo, and A. M. Protti (FIAT, Turin). Am. Ceram. Soc. Bull., 43: 125-7(Feb. 1964).

Materials and processes for sintering Al_2O_3–UO_2 in a hydrogen atmosphere at more than 1600°C are discussed. Micrographic examinations of the results are shown. (R.E.U.)

10507 SINTERING OF TITANIUM DIOXIDE. A. G. Grotyohann and K. Herrington (National Lead Co., South Amboy, N. J.). J. Am. Ceram. Soc., 47: 53-4(Jan. 1964).

The results of sintering rutile in atmospheres of air and nitrogen are reported. Experiments indicated that rutile spheres 78 μ in diameter would sinter in a reasonable time at 1300°C. The results indicate that in air rutile sinters by an evaporation-condensation mechanism. Whisker growth and the formation of crystalline faces were observed at sintering times of 4 to 6 hr. Spheres of both 78- and 53-μ size were sintered simultaneously on separate rutile plates at 1300 and 1350°C in nitrogen. The data indicate that sintering occurs much slower in nitrogen than in air and that the sintering mechanism is different. It was concluded that sintering of rutile in a reducing atmosphere is quite complex. (P.C.H.)

10508 TANTALUM ALLOY SHEET IN PILOT PRODUCTION. D. J. Maykuth (Battelle Memorial Inst., Columbus, Ohio); G. S. Root, and H. R. Ogden. J. Metals, 16: 180-4(Feb. 1964).

The fabrication of two tantalum alloys, Ta-10Hf-5W and Ta-30Nb-7.5V, into sheet bar by extrusion, forging, and rolling was investigated and evaluated. The properties of the resulting sheet, especially its tensile properties and bend and weld ductility, are reported. Indications that sound fusion welds in the Ta-Nb-V alloy cause no appreciable loss in strength or ductility are given. (auth)

10509 MAGNETIC-FORCE WELDING OF SAP MATERIALS. L. E. Mills (General Electric Co., Richland, Wash.). Metals Eng. Quart., 3: No. 3, 33-8(Aug. 1963).

Magnetic-force resistance butt welding is an effective process for making closures on SAP fuel cladding. The resulting cross-sectional area of the weld is larger than the cross-sectional area of the cladding. Continuous control of all welding parameters is required to assure consistent weld quality. Weld evaluation is performed with test specimens welded and tensile tested at frequent intervals during production welding. (auth)

10510 ELECTRON-BEAM VERSUS TIG WELDING OF NIOBIUM AND TANTALUM. Haruyoshi Suzuki, Tatsuya Hashimoto, and Fukuhisa Matsuda. Trans. Natl. Res. Inst. Metals (Tokyo), 5: 76(1963).

Investigations were made on the chemical, mechanical, non-destructive, and corrosive properties of welded joints of 1 mm thick Nb and Ta sheets that were either electron-beam welded in a high vacuum or TIG welded in a controlled welding chamber filled with 1 atm argon gas containing an impurity gas of air, nitrogen, oxygen, or hydrogen. The electron-beam melted Nb specimen showed no porosity with both welding methods. However, sintered Nb specimens showed greater porosities with electron-beam welding. The sintered Ta specimens showed no porosity both with TIG and electron-beam welding. Other properties are also listed. (P.C.H.)

10511 THE SOLDERING OF BERYLLIUM METAL. E. E. Weismantel and K. C. Taber (Beryllium Corp., Reading, Penna.). Welding J. (N. Y.), 43: 57s-62s(Feb. 1964).

The solder compositions, fluxes, and procedures required for Be metal were established and are reported. Surface preparation includes degreasing, acid etching and thorough rinsing. Solder compositions studied contained various percentages of Ag, Pb, Sn, Zn, and In. Flowability was found to be greatest with alloys containing high Zn, In, or Pb and was very sensitive to temperature. Wetting, not as greatly affected by varying temperature, was highest for high Zn and high Pb solders. Joint strengths varied from 400 to over 3000 psi for most solders. However, the high Zn solders produced shear strengths above 10000 psi, approaching the strengths reported for brazed joints. (P.C.H.)

10512 FABRICATION OF THE MOLTEN-SALT REACTOR EXPERIMENT HEAT EXCHANGER CORE INVOLVES A NOVEL WELDED AND BACK-BRAZED JOINT DESIGN FOR TUBE-TO-TUBE SHEET JOINTS. R. G. Donnelly and G. M. Slaughter (Oak Ridge National Lab., Tenn.). Welding J. (N. Y.), 43: 118-24(Feb. 1964).

The INOR-8 tube bundle of the primary heat exchanger of the Molten-Salt Reactor Experiment contains 163½ in. dia × 0.042 in. wall U-tubes welded to a 1½ in. thick tube sheet 18 in. in dia. Procedures were successfully developed for welding and back brazing the 326 closely spaced tube-to-tube sheet joints in the unit, and the actual tube bundle was fabricated without incident. The welded and back-brazed design provides a double seal between the

fuel and coolant salts and was used because of the necessity for high joint integrity. Trepan grooves were machined in the weld side of the tube sheet so that low-restraint edge-type welds could be made. This technique greatly reduces the cracking problems associated with welding thin-walled tubes to thick tube sheets. Welding and assembly procedures were developed, which provided welds of high quality with a minimum of roll-over. The 82 Au–18 Ni (wt. %) brazing alloy used is corrosion resistant, ductile, and produces joints exhibiting satisfactory mechanical strength. A unique joint design incorporating a trepan groove and feeder holes was used for the braze side, the purpose being to prevent preferential flow of alloy on the relatively thin-walled tubes. After the determination of exact welding and brazing conditions on several subsize and full-size mockup samples, the actual unit was constructed. Nondestructive inspection of the welds revealed no defects. Good general flow of the brazing alloy was evident, and ultrasonic examination of brazed joints showed only minor scattered porosity. The completed unit passed both helium leak and 800 psi hydrostatic tests. (auth)

10513 EXTRUSION OF BERYLLIUM STRUCTURAL SHAPES. John M. Siergiej (Nuclear Metals, Inc., Concord, Mass.). 23p. (CONF-375-4)

From 6th National Symposium Society for Aerospace Material Process Engineers, Seattle, Nov. 1963.

Special techniques employed during the extrusion of beryllium are reviewed. It is shown that extrusions of complex shapes can be produced in long lengths. A limitation of the process is that the cross-section of the shape must have width and wall thickness dimensions to enable it to be circumscribed by a circle having an area approximately 12 to 40 times the area of the shape desired; also, that a die design can be developed to ensure cladding flow without breakthrough. Once the process is developed for a particular size and shape, extrusion is an economical method for producing pilot and production quantities of complex cross-sections in long lengths with consistent control of properties and dimensions. (P.C.H.)

10514 METHOD FOR PRODUCING A SINTERABLE SHAPED BODY OF URANIUM DIOXIDE. Henry Lloyd, Neville R. Williams, and Cristopher C. H. Wheatley (to United Kingdom Atomic Energy Authority). German Patent 1,152,684. Aug. 14, 1963. Priority date June 22, 1959, Great Britain.

The method comprises cold pressing a mixture of uranium dioxide (with an O/U atomic ratio less than 2.3) and an organic binding agent, and heating the shaped body. By heating this body in an oxidizing atmosphere to temperatures of 200 to 250°C, the binding agent is disintegrated and the O/U atomic ratio is increased to 2.3. (Gmelin Inst.)

10515 PROCESSES FOR SHEATHING THE FUEL ELEMENTS OF NUCLEAR REACTORS. Claude Beernaert (to Commissariat à l'Énergie Atomique). U. S. Patent 3,118,222. Jan. 21, 1964. Priority date May 11, 1959, France.

The process described permits cladding of reactor fuel elements without variation in sheath thickness during forming. Parallel fuel rods are spaced between metal sheets and are held in place by a plastic, relatively incompressible substance disposed between the rods within the sheets. The metal sheets are compressed around the rods with lateral displacement during sheath formation. (R.E.U.)

10516 PROCESS OF MAKING SHAPED FUEL FOR NUCLEAR REACTORS. William Joseph O'Leary and Eugene A. Fisher (to U. S. Atomic Energy Commission). U. S. Patent 3,121,128. Feb. 11, 1964.

A process for making uranium dioxide fuel of great strength, density, and thermal conductivity by mixing it with 0.1 to 1% of a densifier oxide (tin, aluminum, zirconium, ferric, zinc, chromium, molybdenum, titanium, or niobium oxide) and with a plasticizer (0.5 to 3% of bentonite and 0.05 to 2% of methylcellulose, propylene glycol alginate, or ammonium alginate), compacting the mixture obtained, and sintering the bodies in an atmosphere of carbon monoxide or carbon dioxide, with or without hydrogen, or of a nitrogen-hydrogen mixture is described. (AEC)

10517 GRAPHITE BONDING METHOD. L. D. P. King (to U. S. Atomic Energy Commission). U. S. Patent 3,122,424. Feb. 25, 1964.

A process for bonding or joining graphite members together in which a thin platinum foil is placed between the members, heated in an inert atmosphere to a temperature of 1800°C, and then cooled to room temperature is described. (AEC)

Properties and Structure

10518 (AD-410526) PHASE RELATIONSHIPS OF MOLYBDENUM, NIOBIUM AND TUNGSTEN BORIDES, CARBIDES AND SILICIDES: AN ANNOTATED BIBLIOGRAPHY. Jack B. Goldmann, comp. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). May 1963. 83p. (SB-63-9)

This annotated bibliography of 198 references emphasizes phase relationships and their fabrication as evidenced in the physical properties, refractories, and powder metallurgy of molybdenum, niobium, and tungsten compounds which are formed with boron, carbon, and silicon. The period, 1955 to 1962, yielded the majority of references included in this bibliography. (auth)

10519 (AD-427700(p.311-37)) HEAT TRANSFER AND THERMAL EXPOSURE STUDIES OF RESIN-IMPREGNATED ZIRCONIA FOAM. Eric L. Strauss (Martin-Marietta Corp. Aerospace Div., Baltimore).

Resin-impregnated zirconia foams combine the thermal stability of zirconia with a reduction in surface aerodynamic heating by mass transfer cooling and provide a highly promising heat shield material, especially for lifting reentry vehicle nose caps. Thermal shielding efficiencies were determined by exposing instrumented specimens in a plasma arc to heating rates of 40 to 200 Btu/ft^2-sec for 5 to 25 min. The zirconia matrix exhibited only negligible surface recession due to melting or erosion. Measured values of surface temperature and internal temperature rise were in good agreement with calculated values. Structural reliability of impregnated zirconia composites was evaluated by exposing specimens for 15 min in a hot gas facility under conditions of severe thermal shock and high mass flow, sound level and dynamic pressure. (auth)

10520 (AD-427700(p.339-95)) PYROLYTIC GRAPHITE—A STATUS REPORT. A. M. Garber, E. J. Nolan, and S. M. Scala (General Electric Co. Missile and Space Div., Philadelphia).

A review is presented of the recent history of the development of pyrolytic graphite and its thermal, aerothermochemical, and structural properties with regard to its application to hypersonic vehicles. Pyrolytic graphite is not really new since its discovery dates back to Thomas Edison; however, this class of refractory materials has been "rediscovered" recently because it possesses certain desirable properties at extremely high operating temperatures, including a high strength to weight ratio, low oxida-

tion rate, and a low transverse coefficient of thermal conductivity. Consequently, a thorough investigation of the properties of pyrolytic graphite is being carried out. In addition, theoretical models are being developed so that its aerothermochemical and aerothermostructural behavior can be predicted with confidence for arbitrary hypersonic missions. The currently available property data, and analytical and numerical techniques are presented and discussed critically, and areas for future research and development are delineated. (auth)

10521 (ATL-A-140) INVESTIGATION OF THERMAL-STRESS-FATIGUE BEHAVIOR OF STAINLESS STEELS. Quarterly Progress Report No. 8. K. E. Horton (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). [1963]. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-250. 32p. (EURAEC-946)

Thermal-stress-fatigue (TSF) testing of 304 and 304-L austenitic stainless steels was completed. The testing of ferritic steel (ASTM Type A302, Grade B) and of martensitic stainless steel (Type 403) was 50% completed. TSF and conventional strain-cycling fatigue (SCF) were performed on A302B and 403 steels. A new graphical technique was developed which simplifies the work required to obtain plastic strain range, the variable found to be entirely independent in TSF. The method allows greater accuracy in obtaining this parameter. (auth)

10522 (BMI-X-10072) FISSION-PRODUCT RELEASE FROM FUEL-ELEMENT CLADDINGS. Quarterly Progress Report for October–December 1963. Thomas S. Elleman, George G. Cocks, Josef Bugl, and Arthur A. Bauer (Battelle Memorial Inst., Columbus, Ohio). Jan. 1, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 17p. (EURAEC-936)

Postirradiation heating experiments to study Xe^{133} release from foils of iron-20 wt % chromium-alloy specimens impregnated with fission recoils showed that release is time, temperature, and concentration dependent. An activation energy of 36 kcal per mole is associated with an initial rapid or burst release component while a lower activation energy of 20 kcal per mole appears to be associated with a slower long-time release component. The rate of release is concentration dependent in both components. The gas-release behavior is apparently strongly influenced by gas-bubble formation. In postirradiation heating experiments to measure release of Xe^{133} through material unaffected by fission recoils, no measurable release is observed. Thus, unless irradiation affects the gas-diffusion behavior, significant release by diffusion through the cladding of a fuel element would not be expected. In solid-fission-product studies diffusion coefficients are determined at 600, 800, 1000, and 1200°C for a concentration of 2×10^{13} recoils per cm^2. Diffusion coefficients and activation energies for molybdenum, ruthenium, and high-diffusion-rate components of tellurium and zirconium are about the same as that for the diffusion of chromium in stainless steel. Cerium, barium, iodine, and the slower zirconium component give noticeably lower diffusion coefficients and activation energies. (auth)

10523 (CONF-339-6) NUCLEATION OF SURFACE PITS BY THE CONDENSATION OF VACANCIES. J. R. Jasperse and P. E. Doherty (Little (Arthur D.) Inc., Cambridge, Mass.). June 1963. Contract AT(30-1)-2756. 21p.

The Metallurgical Society of A.I.M.E. Fall Meeting, Cleveland, Oct. 1963.

Small surface pits were observed to form on electropolished (111) surfaces of aluminum single crystals during cooling from elevated temperatures. The formation of these pits was attributed to the condensation of vacancies from the supersaturation produced during cooling at the points of intersection of dislocations with the surface. A finite temperature drop, ΔT, which was a function of the holding temperature, T_h, was required to nucleate the pits. The principles of statistical mechanics when applied to vacancy clustering led to an equation which quantitatively predicted ΔT as a function of T_h. The temperature dependence of the nucleation phenomenon was experimentally measured and found to be consistent with the theoretical predictions. The experimental results led to a corrected value of 1.8×10^{-5} ergs/cm (0.3 ev/plane) for the average dislocation core energy per unit length in aluminum. (auth)

10524 (CONF-342-8) MAGNETIC PROPERTIES OF Eu. G. P. Arnold, C. E. Olsen, and N. G. Nereson (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract W-7405-eng-26. 3p.

From Conference on Magnetism and Materials, Atlantic City, Nov. 1963.

The magnetic properties of Eu metal were studied by neutron diffraction experiments on an improved powder sample. The results verify the transition to an antiferromagnetic state below 91°K; the state is a helical spin structure. The ordered magnetic moment was calculated to be $5.8 \pm 0.4\ \mu_B$. The intensity variation of the magnetic diffraction peaks with temperature was found to deviate from the usual Brillouin pattern. (D.L.C.)

10525 (CONF-342-10) THE MAGNETIC STRUCTURE OF NEODYMIUM. R. M. Moon, J. W. Cable, and W. C. Koehler (Oak Ridge National Lab., Tenn.). [1963]. Contract [W-7405-eng-26]. 7p.

From Conference on Magnetism and Materials, Atlantic City, Nov. 1963.

Neutron diffraction measurements were made on a single crystal of Nd at temperatures between 1.6 and 20°K. The onset of magnetic ordering occurs at 19°K and the magnetic structure changes at 7.5°K. The crystal structure is hexagonal with a four-layer stacking sequence of type ABAC. Thus, alternate layers have different nearest-neighbor environments, either hexagonal or face-centered cubic. The main features of the diffraction pattern can be interpreted on the basis of an approximate model in which the hexagonal sites order at 19°K with an antiferromagnetic arrangement between alternate hexagonal layers and with a sinusoidal modulation within each layer. (auth)

10526 (DMIC-190) THE ENGINEERING PROPERTIES OF MOLYBDENUM AND MOLYBDENUM ALLOYS. F. F. Schmidt and H. R. Ogden (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Sept. 20, 1963. Contract AF33(616)-7747. 288p. (AD-426264)

Results are reported of a state-of-the-art survey covering molybdenum and nine of its most promising alloys. All data are given in tabular and graphical form covering some of the more important physical, mechanical, and metallurgical properties for each material. References are given at the conclusion of each material section. (auth)

10527 (HW-76246) FATIGUE TESTS OF "N" REACTOR PRIMARY PIPE LONGITUDINAL SEAM WELDS CONTAINING PRODUCTION WELD FLAWS. W. J. Love (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 2, 1963. Contract AT(45-1)-1350. 39p.

Results are presented of fatigue tests of ASTM A-155 Class I KC 70 (ASTM A-212 B) pipe containing weld cracks

ranging in size from "acceptable" to the largest flaw size found in destructive examinations. The fatigue strength reductions attributed to the cracks are compared with predictions. Relevant destructive and nondestructive inspection data are also presented. (D.L.C.)

10528 (HW-76246(App.2)) TEST OF NPR PIPE LOOP MATERIAL. Interim Report. William J. Love (Southwest Research Inst., San Antonio). Sept. 17, 1962. For General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Contract AT(45-1)-1350. 31p.

An experiment is being performed to determine the low-cycle fatigue strength of pipe fabricated for an NPR loop. The pipe is A212 Grade B plate rolled into 18-inch cylinders with a longitudinal submerged-arc welded seam. The metallurgical examination of a 22,182-cycle failure area is described. (D.L.C.)

10529 (HW-76246(App.3)) TEST OF NPR PIPE LOOP MATERIAL. Interim Report. William J. Love (Southwest Research Inst., San Antonio). Nov. 9, 1962. For General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Contract AT(45-1)-1350. 23p.

An experiment is being performed to determine the low-cycle fatigue strength of pipe fabricated for an NPR loop. The pipe is A212 Grade B plate rolled into 18-inch cylinders with a longitudinal submerged-arc-welded seam. The physical testing of the test vessels I and II is described. The metallurgical examination of the second failure of the fatigue test model after 33,366 cycles is described. (D.L.C.)

10530 (HW-76246(App.4)) TEST OF NPR PIPE LOOP MATERIAL. Interim Report. METALLURGICAL EXAMINATION OF 73,393 CYCLE BASE METAL FAILURE IN GENERAL ELECTRIC FATIGUE TEST MODEL NUMBER ONE. Robert C. DeHart and R. D. Wylie (Southwest Research Inst., San Antonio). Jan. 28, 1963. For General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Contract AT(45-1)-1350. 17p.

The fatigue test model was internally pressurized for 73,393 cycles before the first base metal failure occurred. This failure followed two previous longitudinal weld defect failures at 22,182 and 33,366 cycles. Results of nondestructive tests and metallurgical examination of this failure are described. (D.L.C.)

10531 (HW-76246(App.5)) TEST OF NPR PIPE LOOP MATERIAL. Final Report on Vessel I. William J. Love (Southwest Research Inst., San Antonio). May 2, 1963. For General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Contract AT(45-1)-1350. 28p.

Two test vessels are being tested to determine the low-cycle fatigue strength of 18-inch A212 B pipe with longitudinal welded seams. The final phase of testing on Vessel I is summarized. Ultrasonic inspection and metallurgical examination of the failures are described. (D.L.C.)

10532 (HW-76246(App.6)) METALLURGICAL EXAMINATION OF 37,393 CYCLE BASE METAL FAILURE IN GENERAL ELECTRIC FATIGUE TEST MODEL NO. 2. K. K. Speirs and C. E. Lautzenheiser (Southwest Research Inst., San Antonio). Apr. 2, 1963. For General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Contract AT(45-1)-1350. 19p.

The fatigue test model No. 2 was internally pressurized for 37,393 cycles before the first failure occurred. This failure was in the base metal. Results of the metallurgical examination of the failure are described. (D.L.C.)

10533 (HW-76246(App.7)) TEST OF NPR PIPE LOOP MATERIAL. Final Report on Vessel II. William J. Love (Southwest Research Inst., San Antonio). June 14, 1963. For General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Contract AT(45-1)-1350. 24p.

Two test vessels are being tested to determine the low-cycle fatigue strength of 18-inch A212 B pipe with longitudinal welded seams. The final phase of testing on Vessel II is summarized. (D.L.C.)

10534 (LA-2995) THE VAPOR PRESSURE OF INDIUM. C. C. Herrick (Los Alamos Scientific Lab., N. Mex.). Oct. 3, 1963. Contract W-7405-eng-36. 31p.

Measurements were made of the vapor pressure of indium as a function of temperature between 1143 and 1422°K employing the torque-effusion technique. The vapor pressure (in atmospheres) of liquid indium is given by the equation $\log P = 5.782 \times 10^3/T - 25.29$ in the experimental range. Extrapolation yields a calculated normal boiling point of 2329°K and a heat of vaporization at 298°K of 58.09 kcal by the third-law method and 58.39 kcal by the second-law method. (auth)

10535 (N63-18835) MATERIAL PROPERTIES HANDBOOK. VOLUME III. MAGNESIUM, NICKEL, AND TITANIUM ALLOYS. (Royal Aeronautical Society, London). 1963. 258p.

Issued by North Atlantic Treaty Organization, Paris. Advisory Group for Aeronautical Research and Development.

Tables are presented on the chemical composition, physical properties, and mechanical properties of Mg, Ni, and Ti alloys which are of interest for structural use in aircraft. Mg casting alloys are included. The data are divided into national sections according to where the alloy is produced: Canada, France, Germany, Italy, Netherlands, U. K., and U. S. A. The mechanical properties covered are static properties, fatigue properties, short-time properties at elevated temperatures, recovered properties after exposure to elevated temperatures, and properties under load and elevated temperatures. (D.L.C.)

10536 (NAA-SR-Memo-8499) MATERIALS SURVEY [OF] ENGINEERING PROPERTIES FOR IRRADIATION EXPERIMENT DESIGN. D. B. Stein (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 19, 1963. Contract [AT(11-1)-Gen-8]. 185p.

A survey of vendor publications and materials literature was made to obtain the physical properties of various materials graphically as a function of temperature in the range from 0 to 2000°F. The need for standardized, readily available up-to-date data prompted this survey. Vendor information was used for most of the materials. Other important sources included the Metals Handbook and the Reactor Handbook. The properties considered include: density, thermal expansion, thermal conductivity, tensile and yield strength, stress to produce 1% creep in 10,000 and 100,000 hr, stress to rupture, modulus of elasticity (Young's Modulus), and Poisson's ratio. (auth)

10537 (NAA-SR-Memo-9015) SINGLE-CRYSTAL AND DENSE-POLYCRYSTAL URANIUM CARBIDE: THERMAL, MECHANICAL, AND CHEMICAL PROPERTIES. S. C. Carniglia (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 31, 1963. Contract AT-11-1-GEN-8. 41p. (CONF-206-5)

From Symposium on Carbides in Nuclear Energy, Harwell, Eng., Nov. 1963.

Essentially 100% dense uranium–carbon compositions ranging on both sides of stoichiometric UC were prepared by arc casting and by electron beam floating-zone refining followed by thermochemical adjustment of composition.

The latter procedure and typical resultant material characteristics are presented. The electrical resistivity of polycrystal U–C compositions increases with increasing carbon content from 4.1 to 9.1 wt % C, and with increasing temperature. The thermal diffusivity of hypostoichiometric UC was measured by the newly-developed laser pulse technique. The calculated thermal conductivity is 0.053 cal/cm°C sec, insensitive to temperature, and appears to decrease below this value with increasing free uranium content in the two-phase hypo system. Thermal expansion is independent of composition ≥4.8 wt % carbon, following the relation: $l = l_{20°C}\,[0.9998 + 1.04 \times 10^{-5}\,(T°C) + 1.17 \times 10^{-9}\,(T°C)^2]$. Hypo UC compositions exceed this expansion with increasing free uranium content, above 400°C; irreversibly above about 850°C. High-temperature bending strength and compressive creep measurements show clear correlations with the single or two-phase structure. UC–U compositions become weak and plastic between 600 and 900°C, while UC–UC_2 and single-phase UC specimens increased in strength with temperature above 900°C, presumably decreasing again at higher temperatures. Studies were carried out of chemical interactions between hypo to hyper uranium carbide and type 304 stainless steel, zirconium–1Mo–1Sn–1.25Al, and niobium–1Zr alloys. Mechanisms and kinetics are described for both sodium-bonded and contact-bonded couples. (auth)

10538 (NP-13539(Paper 14)) BERYLLIUM OXIDE DIELECTRIC COMPONENTS IN AEROSPACE APPLICATIONS. P. S. Hessinger and B. Haura (National Beryllia Corp., Haskell, N. J.).

Recent information on the properties, fabrication, and applications of BeO ceramic dielectric materials is presented. The factors that affect the critical dielectric and thermal properties for space applications are reviewed. (D.C.W.)

10539 (RTD-TDR-63-4096(Pt.I)) INVESTIGATION OF BORIDE COMPOUNDS FOR VERY HIGH-TEMPERATURE APPLICATIONS. Larry Kaufman and Edward V. Clougherty (ManLabs, Inc., Cambridge, Mass.). Oct. 1963. Contract AF33(657)-8635. 389p.

A comprehensive study of the properties of high-purity well-characterized samples of TiB_2, ZrB_2, HfB_2, NbB_2, and TaB_2 was performed. Floating zone refining and high-pressure hot pressing were used to prepare single crystal and polycrystalline material respectively. An investigation of the sintering mechanism of TiB_2 was performed. Powder purification procedures by acid leaching and vacuum heating were examined. Properties measured included lattice parameter, x-ray thermal expansion, linear thermal expansion, electrical resistivity, and microhardness. These quantities were obtained for materials which satisfied the sample requirements for the various experiments. Measurements were generally performed between room temperature and 1000°C. Thermal conductivity measurements between 1000 and 2000°C are in progress. Thermal properties measured included specific heat, vapor pressure, and heat of formation. The latter is in progress. Phase boundary experiments were performed in Zr–B system and the current status of the phase diagrams of these materials was reviewed. Kinetic studies were performed to elucidate the mechanism of oxidation and to study the nature of protective coatings which are produced by some of these materials in oxidizing atmospheres. An integrated thermodynamic analysis of the diborides was completed. On the basis of current vapor pressure and oxidation data, HfB_2 and ZrB_2 are shown to be the most likely candidates for high temperature applications requiring oxidation resistance. The available description of the compositional dependence of the boron activity in these compounds indicates that metal-rich deviations from stoichiometry in these compounds will probably result in additional enhancement of the oxidation resistance. Other variations in composition suggested by the results of the present study include additions of Ta and Nb or Y and La. These elements might serve to impede diffusion of oxygen through the oxide surface layer. Additions of silicon to the pure diborides might also provide enhanced oxidation resistance. (auth)

10540 (TID-20024) AN EVALUATION OF THE ROLE OF DEFORMATION TWINNING IN THE PLASTIC DEFORMATION OF ZIRCONIUM. Quarterly Progress Report No. 9. R. E. Reed-Hill (Florida. Univ., Gainesville. Engineering and Industrial Experiment Station). Nov. 1963. Contract AT(38-1)-252. 37p.

The deformation modes of zirconium under torsion were studied using swaged and annealed polycrystalline wire. Deformation was conducted at 77°K, and polarized light was used in performing single surface determinations of crystal orientations. Twinning was observed to occur primarily on the $\{11\bar{2}1\}$ planes most nearly perpendicular to the torsion axis. Secondary twinning modes were $\{10\bar{1}2\}$ and $\{11\bar{2}2\}$. The predominance of $\{11\bar{2}1\}$ twinning at 77°K is in agreement with earlier work on zirconium strained in tension. Slip trace studies indicate that the principal slip plane in zirconium is $\{10\bar{1}0\}$. Slip is also observed to occur on (0002), $\{10\bar{1}1\}$, and $\{11\bar{2}2\}$ planes. The accommodation kink bands at the ends of $\{11\bar{2}1\}$ twins are believed to be associated with the ability of this twin to grow in a polycrystalline matrix. The growth behavior is important because $\{11\bar{2}1\}$ twinning can be used to improve the ductility of zirconium under many useful combinations of metal texture and applied stress. A growth mechanism involving an interaction between basal slip dislocations and $\{11\bar{2}1\}$ twinning dislocations is discussed. (auth)

10541 (TID-20059) [TESTING LARGE PRESSURE VESSELS]. Progress Report No. 6. Andrew G. Pickett (Southwest Research Inst., San Antonio). Jan. 15, 1964. Contract AT(11-1)-1228. 7p.

Fatigue crack propagation in pressure vessel steels is being studied by cyclic pressure testing of various vessels and by evaluating the effect of weld defects on the plastic fatigue strength of A302B steel plates. Some preliminary results are discussed. (N.W.R.)

10542 (TID-20065) X-RAY STUDY OF THE STRUCTURE OF LIQUID METALS AND ALLOYS. Annual Progress Report. C. N. J. Wagner (Yale Univ., New Haven. Hammond Metallurgical Lab.). Jan. 1964. Contract AT(30-1)-2560. 6p.

Three different x-ray diffraction methods are investigated for studying structure of liquid metals. Methods evaluated are: non-focusing method with stationary x-ray beam irradiating the open surface of a stationary liquid sample, focusing method with θ-motion of the liquid sample covered with a suitable material, and focusing method with stationary x-ray beam irradiating the open surface of a stationary liquid sample. The application of computer methods to the analysis of x-ray scattering from liquid metals is discussed. The properties of liquid copper, silver, tin, and mercury as determined by x-ray diffraction are summarized. Atomic distribution in molten silver–tin alloys is reported. (N.W.R.)

10543 (TID-20117) ACTIVITIES IN LIQUID AND SOLID METAL SYSTEMS. Summary Report, February 1, 1956–January 31, 1963. John F. Elliott (Massachusetts

Inst. of Tech., Cambridge. Dept. of Metallurgy). Jan. 1, 1964. Contract AT(30-1)-1888. 10p.

Thermodynamic properties and phase studies of liquid metallic solutions are summarized. The development of a high-temperature solution calorimeter is discussed. (N.W.R.)

10544 (UCRL-10383) THE FORMATION OF POROSITY DURING DIFFUSION PROCESSES IN METALS (thesis). Dennis M. Maher (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1962. Contract W-7405-eng-48. 71p.

Evidence is presented which indicates that the porosity formed during diffusion processes in Cu–Ni and Ag–Au couples is heterogeneously nucleated in the presence of a relative excess concentration of vacancies resulting from the unequal mass flow of the two participating constituents. The nature and extent of porosity is dependent on the purity of the sample and thus appears to be related to the number or "potency" of nuclei available for vacancy agglomeration. From metallographic observations on the distribution of porosity, it is estimated that pores will form when vacancies are pumped into any small region of the diffusion zone at the rate of about $10^{15}/cm^3/sec$ in oxygen-free high conductivity copper and $10^{17}/cm^3/sec$ in spectroscopically pure copper. The higher supersaturation required for the nucleation of pores in spectroscopically pure copper is consistent with all the qualitative observations made on the formation of porosity. Estimates of the relative fraction of the excess vacancies which condense to form pores on the copper-rich side were obtained in two ways: (1) from the ratio of the overall expansion of the couple to the normal Kirkendall shift, and (2) from the ratio of the measured pore volume to that associated with the net vacancy flux, as derived from concentration-penetration profiles. Both estimates are in reasonable agreement and indicate that upwards of 90% of the excess vacancies agglomerate as pores rather than being annihilated at jogs on dislocations or other sinks; in spectroscopically pure copper; about 50% of the excess vacancies end their lives at pores. It is concluded that, contrary to the usual assumption, dislocations are not very effective sinks for vacancies under conditions (e.g., relatively low vacancy supersaturations) which prevail within the diffusion zone. The observed differences in the extent of porosity in the two grades of copper are believed to be due to differences in nucleating sites available for vacancy condensation rather than to differences in the ease with which dislocation climb can take place in these two materials. Additional observations indicate that the presence of aluminum oxide particles or clusters in silver has influenced the normal distribution of porosity in silver–gold diffusion couples. These particles or clusters may be acting as favorable sites for vacancy condensation. (auth)

10545 (UCRL-11116) DIFFUSION OF IRON INTO SODIUM DISILICATE GLASS (thesis). Marcus P. Borom (California. Univ., Berkeley. Lawrence Radiation Lab.). Nov. 12, 1963. Contract W-7405-eng-48. 41p.

Diffusion couples of elemental iron and degassed sodium disilicate glass rod were prepared under neutral to reducing conditions at several temperatures and at varying times. The diffusion profiles were analyzed by using electron microprobe techniques. Diffusion-coefficient calculations and activation-energy determinations indicated that a change in mechanism was occurring between 1000 and 1050°C. An indication is given by the magnetic-susceptibility measurements that atomic iron is the diffusing species at 900°C and that ferrous iron is the diffusing species at 1050°C. These observations are supported by the transmission-spectroscopy measurements and by theoretical thermodynamic considerations. A discussion of the possible mathematics of the diffusional processes is given. (auth)

10546 (EURAEC-432) STUDY OF THE PROPERTIES OF LOW-CARBON MARTENSITES. Special Report No. 6, April 1 to June 30, 1962. (Société Anonyme des Forges et Ateliers du Creusot, Paris). Work Performed under United States–Euratom Joint Research and Establishment Program. Contract 073-61-12 RDF. 80p. (A translation)

The properties of low-carbon martensites are reviewed and compared. In this study a bibliography is included containing 47 references. At first data of a fundamental character concerning the method of formation and the nature of martensites are recalled. Then the M_s point and the field of martensitic transformation are developed as fully as possible. The critical study of experimental methods is followed by that of the influence of the composition and the conditions of heat treatment. Data on the characteristics of hardness, ductility, and impact strength of untempered martensites are compared; here again the main factor is the composition and especially the carbon content. Special attention is paid to the phenomenon of self-tempering which characterizes low-carbon martensites and which offers a major interest in the study of welds. (N.W.R.)

10547 (JPRS-22697(p.124-38)) CHANGES OF PROPERTIES DURING CYCLIC THERMAL TREATMENT, DURABILITY AND INTERNAL FRICTION OF SAP. A. I. Dashkovskii, A. N. Rozanov, Yu. F. Bychkov, and I. D. Laptev. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263(p.124-38))

TsTO [Tsiklicheskaya Termicheskaya Obrabotka; cyclic thermal processing] causes significant changes in SAP with maximum temperature of cycle being 550°C and higher. Here a decrease of longitudinal and increase of lateral dimensions take place. As a result of TsTO at 500°C and above the material becomes more brittle and brittleness increases with increase of the number of cycles. The mechanical properties are degenerating. The yield strength and plasticity are decreasing. In the temperature range up to 500°C SAP along with highly favorable mechanical properties is also dimensionally stable during TsTO. The SAP plate rolled from a briquet, annealed in a vacuum at 700°C for 2 hours, possesses higher plasticity and somewhat lower strength as compared with normal SAP and does not have any cracks or blisters upon TsTO with heating up to 600°C. SAP-1 of standard composition possesses greater thermal stability than other aluminum alloys. Its durability (100 hours) comprises 5.5 to 7.5 kg/mm^2 at 375°C and 4.0 to 6.5 kg/mm^2 at 450°C. SAP-1 in fine grained unrecrystallized state has an internal friction peak, the height and position of which on the temperature curve depends on the grain size and the content of the second finely dispersed phase in the aluminum — Al_2O_3. (auth)

10548 (JPRS-22697(p.139-45)) THE MECHANICAL PROPERTIES OF BERYLLIUM AFTER ZONE RECRYSTALLIZATION. I. V. Milov, D. M. Skorov, and V. V. Nikishanov. Translation of Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, (May 31, 1963). (OTS-64-21263(p.139-45))

Results are presented of compression tests on specimens cut out from zone-recrystallized Be ingots. The position of the crystallographic axes in the Be grains was determined. Microhardness measurements on vertical sections of the ingots were made which indicated that the

base plane is located in the ingots perpendicularly to the direction of grain growth. The load-deformation curves show that the greatest strength and plasticity are possessed by the initial sectors of the ingots where the purity is greatest. The deformation mechanism and the effects of grain structure are discussed. (D.L.C.)

10549 TEMPERATURE DEPENDENCE OF PARAMAGNETIC SUSCEPTIBILITY, ELECTRIC CONDUCTIVITY, AND HALL EFFECT IN METALLIC SCANDIUM. N. V. Volkenshtein and E. V. Galoshina. Fiz. Metal. i Metalloved., 16: 298-301(Aug. 1963). (In Russian)

Electric conductivity and paramagnetic susceptibility of 99.86% Sc (0.04% Cu, < 0.01% Mo, 0.03% Fe, 0.016% N_2, 0.034% O_2, 0.002% H_2, and 0.008% Ca) were studied at room to liquid helium temperatures. Specific electric conductivity at room temperature was $\rho_{293°K} = 73$ μohm · cm. A monotonous drop in electric conductivity was observed from room to liquid helium temperature. At 70 to 293°K the ρT is a linear function with constant temperature coefficient $d\rho/dT = 0.28$ μ ohm/cm · degrees. Measurements of Hall effect at room and liquid nitrogen, hydrogen, and helium temperatures showed a linear dependence on the field and a negative sign. Hall coefficient magnitude was $R_{293°K} = 0.67 \times 10^{-12}$ v · cm; with lower temperature the R magnitude is -0.30×10^{-12} v · cm. The current carrier mobility at room temperature is 0.9 $cm^2/sec \cdot v$. (R.V.J.)

10550 MAGNETIC PROPERTIES OF IRON–GADOLINIUM ALLOYS. V. I. Chechernikov, I. V. Burov, and E. M. Savitskii (Moscow State Univ. and Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Fiz. Metal. i Metalloved., 16: 324-8(Sept. 1963). (In Russian)

Magnetic properties of Fe–Gd alloys at temperatures below and above the Curie point were analyzed. Data were collected on the effective magnetic moment (p_a) as a function of composition. The magnetization as a function of temperature suggests antiferromagnetic exchange interactions in the system. (R.V.J.)

10551 EFFECTS OF TENSILE FORCES ON AGING PROCESSES IN BERYLLIUM BRONZE. M. G. Lozinskii, V. S. Mirotvorskii, and A. G. Rakhshtadt. Fiz. Metal. i Metalloved., 16: 366-9(Sept. 1963). (In Russian)

Data in microhardness at 300, 350, and 400°C were used for analyzing aging in beryllium bronze (BrB-2.5) and the effects of tensile forces on the aging process. Effects of tensile forces at 300, 350, and 400°C are related to a transition from a two- to a single-phase system. (R.V.J.)

10552 INVESTIGATION OF ANNEALED Mg–Mn AND Mg–Zr ALLOYS. N. I. Varich and B. N. Litvin (Dnepropetrovsk State Univ., USSR). Fiz. Metal. i Metalloved., 16: 526-9(Oct. 1963). (In Russian)

The influence of fast cooling rates on solid solution saturation by manganese and zirconium in magnesium base alloys, on decomposition of strongly saturated solid solutions as a function of annealing temperature, and on isothermal tempering was investigated. At rapid cooling rates the liquid as phases of Mg–Mn and Mo–Zr area increased. Decomposition of strongly saturated phases takes place at 250 to 300°C. (R.V.J.)

10553 TEMPERATURE EFFECTS ON HARDNESS OF Ti–Zr ALLOYS. V. V. Glazova and N. N. Kurnakov. Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Met. i Gorn. Delo, No. 6, 152-4(Nov.-Dec. 1963). (In Russian)

The hardness of Ti–Zr alloys as a function of temperature was analyzed. Diagrams were constructed for $\alpha \rightarrow \beta$ transitions, and effects of structure at the $\alpha \rightarrow \beta$ transition point on mechanical properties were determined. (R.V.J.)

10554 PHASE EQUILIBRIUM STUDIES IN THE SYSTEM ThO_2–B_2O_3. D. E. Rase (New York Univ., New York) and G. Lane. J. Am. Ceram. Soc., 47: 48-9(Jan. 1964).

The system ThO_2–B_2O_3 was characterized by one stable intermediate phase, thorium borate (ThB_2O_5), and two eutectics. One eutectic occurred between ThB_2O_5 and B_2O_3 at about 98 mole % B_2O_3 and somewhat less than 325°C where thorium borate and boric oxide coexist with liquid. The other eutectic was between ThB_2O_5 and ThO_2 at about 18 to 20% B_2O_3 and slightly less than 1483°C. However, the eutectic mixture contained very little (less than 2%) ThO_2 and melted completely at a very low temperature. (P.C.H.)

10555 DIELECTRIC PROPERTIES AND PHASES OF SOME Ga_2O_3–Nb_2O_5 CERAMIC COMPOSITIONS. F. A. Philgreen (Sandia Corp., Albuquerque, N. Mex.). J. Am. Ceram. Soc., 47: 49-50(Jan. 1964).

The dielectric properties of five compositions in the oxide system Ga_2O_3–Nb_2O_5 were measured to ascertain if any phases were ferroelectric. The dielectric constant curve for the $Ga_2O_3 \cdot 3Nb_2O_5$ ceramic showed a positive slope. High values for dielectric loss appear to be associated with the compositions containing greater than a 1/1 ratio of Nb_2O_5. At lower frequencies, the curves for compositions containing excess Nb_2O_5 rose even more rapidly, showing very high values for the dielectric constant and loss tangent. No maxima were observed. The various ceramic compositions were subjected to an electric field of 32 kv per cm using a manually operated direct-current looping apparatus at room temperature. No ferroelectric hysteresis loops were observed. (P.C.H.)

10556 CURRENT FLOW IN VERY THIN FILMS OF Al_2O_3 AND BeO. Dietrich Meyerhofer and Stefan A. Ochs (RCA Labs., Princeton, N. J.). J. Appl. Phys., 34: 2535-43(Sept. 1963).

A study of current flow through very thin insulating films is described. Several possible conduction mechanisms are presented, and their properties are discussed. The dominant conduction process in the layers studied is quantum-mechanical tunneling. Previous work on this mechanism is extended by an exact calculation that shows the current-voltage characteristic to be divided into three regions of different logarithmic curvature. The dielectric constant of the insulator is found to have a large effect, via the image force, on the tunneling current. The theoretical results are fitted to measurements made on insulating layers less than 100 Å thick, sandwiched between metal electrodes. For Al_2O_3 layers the fit is excellent, resulting in barrier heights of 2.0–2.5 ev and thicknesses approximately 25 Å less than the values determined from capacitance, as expected. In contrast the conduction characteristics of BeO layers can be explained by tunneling only in the low-voltage region; barrier height and thickness are similar to the Al_2O_3 case. At intermediate voltages the currents are lower than predicted, and at high voltages reproducible hysteresis effects are observed with time constants of the order of minutes. These effects are only weakly temperature dependent. They appear to be due to tunneling from one of the metals into trap states in the forbidden gap of the insulator, creating space charge that distorts the barrier for tunneling. (auth)

10557 DEFORMATION OF GRAPHITE BY THERMAL CYCLING. G. M. Jenkins and G. K. Williamson (Central Electricity Generating Board, Berkeley, Gloucestershire, Eng.). J. Appl. Phys., 34: 2837-41(Sept. 1963).

The dimensional changes that occur when graphite specimens are thermally cycled under constant torque were measured. It is shown that internal stresses due to the

anisotropic thermal expansion of individual component crystallites cause strain increments to appear that are a function of the temperature change — not of the absolute temperature. A model used to describe the stress-strain relation of graphite at constant temperature is extended to describe this new phenomenon in terms of a change in internal stress distribution with change in temperature. (auth)

10558 SOME THERMOELECTRIC PROPERTIES OF POLYCRYSTALLINE LANTHANUM TELLURIDE, $LaTe_{1.7}$ TO $LaTe_{2.0}$. T. H. Ramsey, H. Steinfink, and E. J. Weiss (Univ. of Texas, Austin). J. Appl. Phys., 34: 2917-18 (Sept. 1963).

The Seebeck coefficient, electric and thermal conductivity, and thermoelectric efficiency were determined for $LaTe_{1.70}$ to $LaTe_{2.0}$, and the Seebeck coefficient was plotted as a function of composition. (C.E.S.)

10559 CRITERION OF SURFACE ROUGHNESS APPLIED TO REFLECTION BY FLUORIDE INTERFERENCE FILMS ON URANIUM DIOXIDE. REFRACTIVE INDEX OF URANIUM DIOXIDE. Walton P. Ellis (Los Alamos Scientific Lab., N. Mex.). J. Opt. Soc. Am., 54: 265-6(Feb. 1964). (LADC-6008)

The determination of refractive indices of fluoride interference films on the flat surfaces of fused uranium dioxide by immersion spectrophotometry is discussed. The criterion of Bousquet for the equation for normal reflection in air at rough dielectric interfaces with the assumption of no diffusion is applied with surface roughness very much less than the wavelength divided by 10. (R.E.U.)

10560 THE BEHAVIOR OF MATERIALS AT HIGH TEMPERATURES. C. D. Pears (Southern Research Inst., Birmingham, Ala.). Metals Eng. Quart., 3: No. 1, 31-43 (Feb. 1963).

At temperatures above 3000°F, and up to 5500°F, the behavior of refractory materials may change drastically so that average values cannot be used. The design of a structure may require special consideration at lower temperatures, for example 2000°F, to permit performance until the higher temperature is obtained. At the higher temperatures, the environmental conditions of pressure and chemistry have special significance. Also, the specific history of the material can influence the temperature-time relations and the metallurgical structure that can be influential in establishing the values of the properties. The old concepts, including tension modulus, thermal expansion, and emittances, require new definition and often must be treated as transient in time. (auth)

10561 TERNARY COMPOUNDS CONTAINING CARBON (V–Ge–C, Nb–Ga–C, Ta–Ga–C, Ta–Ge–C, Cr–Ga–C, AND Cr–Ge–C). W. Jeitschko, H. Nowotny, and F. Benesovsky (Universität, Vienna). Monatsh. Chem., 94: 844-50(1963). (In German)

Mixtures were heated in quartz ampules at 1000°C for 80–300 hr. The phases V_2GeC, Cr_2GaC, and Cr_2GeC were identified as H phases; evaluations of their powder patterns are tabulated. Their crystal parameters are: V_2GeC, a = 3.00_1, c = 12.25 Å, c/a = 4.08_3; Cr_2GaC, a = 2.88_8, c = 12.61_8 Å, c/a = 4.37_0; Cr_2GeC, a = 2.95_4, c = 12.08 Å, c/a = 4.09_1. Calculated densities are: 5.76, 6.78, 6.86 g/cm³, respectively. The shortest interatomic distances in Å are: for V_2GeC, V–C = 2.03, V–Ge = 2.65, V–V = 2.73(3), Ge–Ge = 3.00; for Cr_2GaC, Cr–C = 1.99, Cr–Ga = 2.66, Cr–Cr = 2.73(3), Ga–Ga = 2.89; for Cr_2GeC, Cr–C = 1.99, Cr–Ge = 2.63, Cr–Cr = 2.67(3), Ge–Ge = 2.95. The phases $Nb_5Ga_3C_x$, $Ta_5Ga_3C_x$, and $Ta_5Ge_3C_x$, containing 5–10% C, have the Mn_5Si_3 structure (D 8_8 type). Lattice parameters in Å are: for $Nb_5Ga_3C_x$, a = 7.72, c = 5.27, c/a = 0.682; for $Ta_5Ga_3C_x$, a = 7.66_1, c = 5.28_0, c/a = 0.689_2; for $Ta_5Ge_3C_x$, a = 7.58_6, c = 5.21_7, c/a = 0.687_7. With increasing transition metal the series in phases was found to be β–Mn, D 8_8, H, perovskite. H phases appear to exist in Ti–Ge–C and Ti–Ga–C; in V–Si–C and Cr–Si–C, D 8_8 phases predominate over H phases. In Mn–Si–C, a D 8_8 phase is noted with larger parameters than in Mn_5Si_3. In Re–Si–C, an H phase and another unidentified; in Fe–Si–C only a D 8_8 phase (no H); in Zr–Ge–C, D 8_8 and possibly a stable H phase; in V–Ge–C, H and D 8_8, both in equilibrium with Ge; in Nb–Ge–C, D 8_8, $NbGe_2$ (T 1) and NbC in equilibrium; in Ta–Ge–C, equilibrium between D 8_8 and TaC; in Cr–Ge–C, D 8_8, H, and Ge in equilibrium; in Mo–Ge–C, D 8_8 and an unidentified phase; in W–Ge–C, W–Ge binary compounds; in Mn–Ge–C, only D 8_8 Mn_5Ge_3, Ge, C, and an unidentified phase (no H) in Fe–Ge–C, a little H phase, α–Fe, $FeGe_2$, and a NiAs-type phase containing C (a = 4.03_2; c = 5.02_4; c/a = 1.246) were noted. (BBB)

10562 DILATION AND THERMOELECTRIC POWER OF α PLUTONIUM AT LOW TEMPERATURE. R. Lallement (Centre d'Études Nucléaires, Fontenay-Aux-Roses, France). Phys. Chem. Solids, 24: 1617-24(Dec. 1963). (In French)

The dilatation and thermoelectric power of plutonium were measured at low temperature. The thermoelectric power is anomalous around 50°K. The dilatation has a minimum around the same temperature. These anomalous properties are assumed to be induced by a magnetic transition. Using Rocher's main ideas it is shown that it is necessary to suppose that the Néel temperature of plutonium decreases when pressure increases to explain the anomalous dilatation. (auth)

10563 LOW-TEMPERATURE HEAT CAPACITIES OF POTASSIUM, RUBIDIUM, AND CESIUM. William H. Lien and Norman E. Phillips (Univ. of California, Berkeley). Phys. Rev., 133: A1370-7(Mar. 2, 1964). (UCRL-8990 (Rev.))

The heat capacities of potassium, rubidium, and cesium were measured between 0.2 and 4.2°K. The thermal effective mass ratios are 1.25, 1.26, and 1.43, respectively. For potassium and rubidium these quantities are in reasonable agreement with theoretical estimates of the effects of band structure, electron-electron interactions, and electron-phonon interaction. The trends of the calculated and measured values suggest that the energy-band calculations overestimate the distortion of the Fermi surface in cesium. For potassium the elastic constants are known and can be compared with the observed T^3 term in the lattice heat capacity. The agreement is within the expected experimental errors. The T^5 term, however, does not agree with calculations based on a model that includes only first- and second-neighbor interactions. (auth)

10564 THE ELECTRONIC PROPERTIES OF LIQUID METALS. N. E. Cusack (Birkbeck Coll., London). Rept. Progr. Phys., 26: 361-409(1963).

Recent experimental work on the electronic properties of liquid metals that show how these properties change at the melting point and vary with temperature in the liquid state are summarized and discussed. The difficulty of explaining the phenomena by methods that are orthodox in solid state physics is pointed out and some simple models suited to liquids are described and compared. More fundamental attempts to obtain the density of states and mean free path from a direct approach to Schroedinger's equation are outlined. It is emphasized that many unsolved problems remain. 126 references. (auth)

10565 PRECISION LAPPING DEVICE FOR THE DETERMINATION OF DIFFUSION COEFFICIENTS IN CERAMIC MATERIALS. H. J. de Bruin and Ralph L. Clark (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr., 35: 227-8(Feb. 1964).

A simple, inexpensive device for the determination of beryllium self-diffusion coefficients in beryllium oxide of the order of 10^{-9} cm^2/sec is described. The precision of thickness measurements on the manual lapping device is ±1 μ. (C.E.S.)

10566 STUDIES OF ZIRCONIUM ALLOYS FOR LIGHT WATER COOLED NUCLEAR REACTOR. Goro Ito, Ryukiti R. Hashiguti, Masayoshi Hasegawa, et al. Rika Gaku Kenkyusho Hokoku, 39: 81-112(1963). (In Japanese)

10567 A STUDY ON HIGH TEMPERATURE STRESS RUPTURE PROPERTIES OF LARGE WELDED JOINT OF STAINLESS CLAD STEEL FOR ATOMIC REACTOR. Haruyoshi Suzuki, Michio Inagaki, Toyoaki Bada, and Otomaro Takagi. Trans. Natl. Res. Inst. Metals (Tokyo), 5: 31(1963).

Stress rupture tests with a 40 ton tester were conducted at 500 and 600°C on large welded specimens of stainless-clad steel, Mn–Mo–Ni steel ASTM A302B clad with AISI 304L. Test results at 600°C under a stress of 12 kg/mm^2 showed that the rupture time of transverse as-welded specimen was 55% of the base metal. The rupture times of transverse welded specimens decreased through heat treatments after welding at 550, 650, and 870°C × 1.5 hr as low as 40, 60, and 90%, respectively, of as-welded specimen. The test results at 500°C, however, showed 45 degrees shear type fracture. (P.C.H.)

10568 THE CONDUCTIVITY OF STRONGLY COMPRESSED MATTER. A. A. Abrikosov (Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 2038-47(Dec. 1963). (In Russian)

Processes determining the conductivity of strongly compressed matter are considered for various temperatures and densities. It is shown that in the solid modification of strongly compressed hydrogen, which possesses a closed Fermi surface, the conductivity is much greater than that of solid modification of other elements. The conductivity of various liquid modifications of strongly compressed matter is also considered as well as the conductivity under conditions when the electrons are ultrarelativistic. (auth)

10569 PREPARATION AND PROPERTIES OF HIGH-MELTING CARBIDE ALLOYS. G. V. Samsonov and V. N. Naderno (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Zh. Prikl. Khim., 36: 2759-62(Dec. 1963). (In Russian)

An analysis was made of temperature and pressure effects on ZrC and HfC sintering. The results showed that the most dense (2 to 5% porosity) specimens were prepared by hot pressing at 2900°C for ZrC and HfC and at 3000°C for HfC and TaC. (R.V.J.)

10570 GRAIN REFINEMENT OF URANIUM BILLETS. L. Lewis (to U. S. Atomic Energy Commission). U. S. Patent 3,122,458. Feb. 25, 1964.

A method of refining the grain structure of massive uranium billets without resort to forging is described. The method consists in the steps of beta-quenching the billets, annealing the quenched billets in the upper alpha temperature range, and extrusion upset of the billets to an extent sufficient to increase the cross sectional area by at least 5 per cent. (AEC)

Radiation Effects

Refer also to abstract 10346.

10571 (AD-409118) THE EFFECTS OF HIGH-ENERGY RADIATION ON INSULATORS. Progress Report No. 2, September 1, 1962–February 28, 1963. Hartmut P. Kallmann (New York Univ., New York). Apr. 1963. Contract DA36-039 SC-89180. 6p.

The influence of lattice vibrations on the annihilation cross sections of positrons in insulators is summarized. At constant volume the annihilation rate increases as the mean square amplitudes of the lattice vibrations so that at high temperatures, the temperature coefficient of the annihilation rate becomes inversely proportional to the elastic constants of the lattice. The effects of x-rays and ultraviolet light on the polarization of anthracene crystals in contact with conducting glass electrodes are investigated. The polarization obtained after 60 min of x-ray irradiation is 5% of the ultraviolet polarization. (N.W.R.)

10572 (CONF-373-2) BEHAVIOR OF REFRACTORY METAL-CLAD PLUTONIUM ALLOY FUEL UNDER IRRADIATION. J. H. Kittel and W. N. Beck (Argonne National Lab., Ill.). [1962]. Contract [W-31-109-eng-38]. 14p.

From Technical Conference on Applied Aspects of Refractory Metals, Los Angeles, Dec. 1963.

Irradiation experiments are in progress to determine the suitability of cladding made of refractory metals and alloys as a means of restraining the high-temperature swelling of metallic plutonium fuels for fast reactors. Tubing materials based on niobium, molybdenum, tantalum, and vanadium are being evaluated, as well as duplex tubing consisting of a high strength nickel alloy lined with tungsten. The feasibility of using cladding for restraint of fuel swelling was found to be highly dependent upon the quality of the tubing used for cladding. Fuel burnups exceeding 2.5 at. % were achieved suecessfully in good quality tubing with wall thicknesses on the order of 0.009 in. (auth)

10573 (GEAP-4296) ENVIRONMENTAL TESTING OF A B_4C–Ni PROTOTYPE CONTROL ROD. F. H. Megerth and D. L. Zimmerman (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Oct. 15, 1963. Contract AT(04-3)-189. 36p.

A prototype control rod containing absorber plates made from an electro-deposited dispersion of boron carbide in nickel was tested in the VBWR. It was exposed to the reactor environment of 545°F boiling water and thermal neutron fluxes (perturbed) which ranged from 0.6 to 1.1 × 10^{13} nv for 2236 hours over a period of six months. The maximum B^{10} burnup achieved during the test period was 1.8 percent. After irradiation, the rod was examined. The results of the examination are summarized below: (1) The B_4C–Ni plate assembly did not undergo significant dimensional changes during irradiation. (2) Numerous blisters developed on both the outer and inner surfaces of three of the four plates. Blistering was more severe on the outer surface than on the inner, and was most severe in a large region located in the lower half of plate 4. Metallographic examination revealed that the blisters were located only in the 2-mil protective nickel overlay covering the B_4C–Ni dispersion. It was concluded that they formed from the buildup of gas pressure at the Ni : Ni–B_4C interfaces, rather than from corrosion attack. Helium from the $B^{10}(n,\alpha)Li^7$ reaction probably contributed to this pressure. However it is conjectured that the major gas was very likely hydrogen, possibly generated and dissolved in

the nickel during electroplating and then released to defects at the Ni : Ni–B_4C interface during reactor exposure. The variation in the degree of blistering among the four plates of the prototype indicated that the blistering was related to variations in the fabrication process. Failure of the nickel overlay was not observed in any of the blisters examined metallographically, and the underlying B_4C–Ni appeared to be in good condition. (3) Evidence of corrosion attack of the B_4C was observed in the form of white deposits on both the inner and outer surfaces of the plates. On the outer plates these deposits were concentrated primarily near regions where the B_4C–Ni layer was unprotected by the nickel coat, namely, screw hole locations. Metallographic examination revealed definite evidence of corrosion attack in the unprotected screw hole surfaces. (4) The deposition of white corrosion products was more extensive on the inner plate surfaces than on the outer surfaces. Corrosion attack of the nickel coat on an inner surface was observed in a region of close contact between the absorber plate and stainless steel support frame. Metallographic examination revealed that this attack was localized and extended through a maximum of 50% of the nickel coat thickness. Corrosion test coupons fabricated from plate material similar to that used in the control rod were also irradiated in the VBWR. Because of their location in a higher neutron flux region and longer exposure period (5000 hours), they reached a B^{10} burnup of 12.2%. Post-irradiation examination of these specimens revealed no evidence of blistering in the nickel coat. The edges of the B_4C–Ni layers unprotected by the nickel coat suffered severe corrosion attack, and thickness increases up to 6% were detected. The corrosion attack and swelling were much more severe than that observed in an earlier group of specimens irradiated to 3% burnup. Direct visual examination revealed no attack of the nickel coat; however, metallographic examination revealed attack which penetrated up to two-thirds of the nickel's thickness. (auth)

10574 (GEAP-4359) MARITIME LOOP IRRADIATION PROGRAM FOR SAVANNAH I FUEL POST-IRRADIATION EXAMINATION OF SI5BM FUEL ASSEMBLY. P. W. Mathay (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Oct. 1963. Contract AT(04-3)-189. 80p.

A stainless steel clad 9-rod fuel assembly fabricated by The Babcock & Wilcox Company was irradiated in a boiling water loop of the General Electric Test Reactor. A post-irradiation examination revealed no significant dimensional changes on the fuel rods. The results of mass spectrometric analysis made of the pelletized UO_2 fuel indicated a maximum burnup of 11,500 Mwd/tonne was attained by Rod B-4 during the exposure. An x-ray-diffraction examination of an unirradiated fuel sample revealed the presence of UN_2 and U_2N_2 phases. Metallographic examination of the irradiated microstructures revealed similar second-phase particles. (auth)

10575 (NP-13539(Paper 4)) SOME EFFECTS OF SIMULATED SPACE ENVIRONMENT ON THE ELECTRICAL PROPERTIES OF DIELECTRICS. L. J. Frisco, A. M. Muhlbaum, and E. A. Szymkowiak (Johns Hopkins Univ., Baltimore. Dielectrics Lab.).

The d-c conductivity, a-c losses, flashover strength, and electric strength of dielectric specimens exposed to x and uv radiation at pressures near 10^{-6} torr were measured. Uniform field sparkover measurements were also made with and without x radiation. (D.C.W.)

10576 (NP-13539(Paper 5)) HIGH ENERGY ELECTRON IRRADIATION OF PLASTICS FOR COMMUNICATIONS SATELLITES. J. V. Pascale, D. B. Herrmann, and R. J. Miner (Bell Telephone Labs., Inc., Murray Hill, N. J.).

The effects of ionizing radiation on the electrical and mechanical properties of 45 plastics being considered for use in communication satellites are described. A maximum total electron flux of 5.8×10^{16} electrons/cm^2 was used. The styrene polymers were the most resistant to radiation, while the acrylics, cellulosics, and fluorocarbon polymers showed severe degradation. (auth)

10577 (NP-13539(Paper 7)) THE EFFECTS OF HIGH ENERGY RADIATION ON THE POLARIZATION CURRENTS IN SOME GLASSES. R. A. Weeks and E. Lell (Oak Ridge National Lab., Tenn.).

Some glasses are electrostatically charged by electron or gamma irradiation and exhibit discharge effects afterwards. The time, dose, and voltage dependence of polarization currents in such glass were investigated. The results support the hypothesis that the polarization effects occur in the bulk of the glass. The bulk polarization processes that have long, approximately temperature-independent relaxation times possibly furnish the mechanism by which charge and energy are stored during irradiation. No correlation was established between long relaxation times and the discharge effect. (D.C.W.)

10578 (NP-13539(Paper 8)) SPACE SIMULATION AND ITS EFFECTS ON MATERIALS. G. R. Blair (Hughes Aircraft Co., Culver City, Calif.).

Some experiments on thermal control surfaces, elastomers, and optical materials for space applications are summarized. The experimental techniques are described, and some typical results are presented. (D.C.W.)

10579 (TID-20064) RADIATION EFFECTS IN SOLIDS. Report for the Period April 1, 1963–March 31, 1964. (Carnegie Inst. of Tech., Pittsburgh). Jan. 17, 1964. Contract AT(30-1)-3033. 15p.

Investigations of the general types of point defects produced by x-irradiation have continued with particular emphasis being placed on distinguishing between Schottky and Frenkel disorder. Asymmetric line broadening was observed in all materials investigated, that is LiF, NaCl, KCl, KBr, and KI. Results indicate that the small amount of line broadening is not due to particle size effects but is associated with lattice strain. The thermal expansion coefficient is apparently increased by x-irradiation, probably by relaxations around point defects. In an effort to characterize interstitial defects investigations are being made of annealings at low temperatures. Information is also included on: F center formation kinetics at room temperature, plastic deformation of lithium fluoride crystals, M band formation at low temperatures, defect production by low energy photons, and interaction of dislocations with charge defects. (N.W.R.)

10580 (USAELRDL-TR-2299) PULSED NUCLEAR-RADIATION-INDUCED TRANSIENTS IN ELECTRONIC PARTS AND MATERIALS (GODIVA IV & V). H. J. Degenhart, W. Schlosser, and H. Bruemmer (Army Electronics Research and Development Lab., Fort Monmouth, N. J.). Jan. 1963. 56p. (AD-409579)

Pulsed nuclear radiation-induced changes in the electrical characteristics of electronic parts and materials obtained in two experiments at the Godiva II Reactor (Los Alamos) are described and discussed. The electronic parts investigated and monitored during exposure include coaxial cables, resistors, capacitors, rectifiers, and magnetic cores of various types, values, and materials. Most of the parts during exposure show transient parameter changes which exceed the tolerance values and then generally recover to their nominal values some time after completion of the radiation pulse. Some of the data show inconsisten-

cies which prevent definite and quantitative conclusions at the present time. In some cases, e.g., low and high value resistors, NiCr thinfilm resistors of various values, and ceramic capacitors, the data show certain repetitive patterns in the behavior of these parts which seem to permit a limited qualitative prediction of the responses of these components under similar environmental conditions. Experiments at Godiva-type (pulsed) facilities are being continued. (auth)

10581 (WAPD-T-1622(Rev.)) NEUTRON SPECTRAL EFFECTS ON INTERPRETATION OF RADIATION DAMAGE EXPOSURE. K. Shure (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 1963. Contract AT-11-1-GEN-14. 18p. (CONF-187-48)

From American Nuclear Society Meeting, New York, Nov. 1963.

The exposure time to achieve an anticipated change in mechanical property of ferritic steel, specifically the inner surface of a reactor vessel wall, as a consequence of neutron irradiation, was examined using a more realistic model of damage cross section which differs from that usually employed in design procedures and using an alternative more realistic technique for interpreting the sample irradiation flux above 1 Mev. This study considered both nickel-58 and iron-54 threshold reactions as monitors. It is concluded that the results obtained are relatively insensitive to the monitor material. Likewise, it is concluded that without introducing any new damage model, the exposure fluxes and therefore the exposure times obtained are relatively insensitive to the spectrum used in the interpretation of monitor activities. The exposure time necessary to achieve a given property change does depend on the damage cross section model, to the extent of about 20% for the model investigated relative to that currently used. The effect of a changing neutron spectrum through a reactor vessel wall on the attenuation of the damage inducing exposure was examined using this damage cross section model. It is concluded that accounting for such spectrum variations results in an apparent attenuation coefficient for the exposure which is reduced from about 0.145 cm^{-1} to about 0.081 cm^{-1}. This reduction in attenuation coefficient results in less attenuation through the vessel wall than predicted by present methods, implying a larger exposure for the outer regions of the wall and hence a larger change in transition temperature than predicted by present methods. (auth)

10582 MOBILITY OF IONS IN DIELECTRIC LIQUIDS OF HIGH VISCOSITY. B. Jachym (Technical Univ. of Danzig). Acta Phys. Polon., 24: 785-90(Dec. 1963).

The mobility of the negative and positive ions created by x rays was measured in paraffin oils with viscosity coefficients 1.6, 0.52, 0.26, and 0.044 P. The relation between ion mobility and viscosity coefficient can be expressed by the formula $u = A\eta^{-\kappa}$ ($\kappa = W/W\eta$ the ratio of corresponding activation energies). For the negative ions this ratio is almost equal to unity and the Stokes law is satisfied. For the positive ions the κ-value is greater than unity and the above equation is close to Adamczewski's relation $u = A\eta^{-\frac{5}{6}}$. (auth)

10583 EFFECT OF FAST-NEUTRON IRRADIATION ON MAGNETIC PROPERTIES AND CRITICAL TEMPERATURE OF SOME TYPE II SUPERCONDUCTORS. P. S. Swartz, H. R. Hart, Jr., and R. L. Fleischer (General Electric Research Lab., Schenectady, N. Y.). Appl. Phys. Letters, 4: 71-3(Feb. 15, 1964).

Experimental results are given for fast-neutron irradiation effects on niobium, Nb–Ta, Nb_3Sn, Nb_3Al, V_3Ga, and V_3Si. (R.E.U.)

10584 THE KINETICS OF THE SWELLING OF FISSIONABLE MATERIALS, PRODUCED BY THE RELEASE OF A GASEOUS PHASE FROM THE SUPERSATURATED SOLID SOLUTION. V. M. Agranovich, E. Ya. Mikhlin, and L. P. Semenov. At. Energ. (USSR), 15: 393-403(Nov. 1963). (In Russian)

The radioinduced swelling of fissionable materials, i.e., the marked volume increase at high temperatures during or after neutron irradiation, prevents the fuel from reaching burnup levels needed for the economical operation of the reactor. The complex mechanism of swelling includes the formation of supersaturated solutions of inert gases in the system, resulting in the release of a gaseous phase; this is accompanied by the creation and subsequent growth of pores. The kinetics of the diffusion of the gases is controlled by both the creep of the material subjected to the pressure of the gas held in the pores and the propagation of the vacancies toward the pores. The flow of the vacancies is assumed to be related to that of the gas atoms and therefore the gas pressure within a given pore is compensated by the surface tension. If the diffusion of vacancies is the controlling factor in the pore growth, the volume change must follow an exponential law of time; if a creep mechanism prevails, the volume change remains independent from the pore growth mechanism. An asymptotic solution of the swelling process was derived, determining the asymptote of the change of the number of the pores and of their average dimensions. (TTT)

10585 ESTIMATION OF THE NEUTRON RADIATION DOSE WHICH CHANGES THE MECHANICAL PROPERTIES OF PURE METALS. V. K. Adamovich. At. Energ. (USSR), 15: 430-2(Nov. 1963). (In Russian)

Knowledge of the fast neutron flux is not sufficient per se to determine radiation-induced damage in metals. The number of point defects was previously used as an indicator of the dose but these defects are not sufficient because they do not affect most of the important physical and mechanical properties. Therefore an attempt was made to estimate the effectiveness of the radiation on the basis of changes of these properties, including yield strength, tensile strength, or elongation. On the basis of the considerations advanced by J. Brinkman (J. Appl. Phys. 25: 961(1954); Amer. J. Phys. 24: 246(1956)), it is shown that as the displacement of the peaks and the accumulation of vacancies created by fast neutrons equals the number of knocked-out atoms, which have an energy E_t higher than a certain threshold value; for displacement peaks $E_t = 400$ ev. In order to accumulate vacancies, $E_t = 6E_d$ where E_d designates the energy required for the displacement. If the energy of the atom is less than $6E_d$, only single or double vacancies are created. A formula was derived for determining the number of primary knocked-out atoms having an energy higher than E_t. The formula does not allow the determination of the number of complex defects at high radiation dose levels because absorption starts at 10^{20} n/cm^2. The point defects do affect markedly certain properties, such as electrical resistivity, modulus of elasticity, diffusion, etc. (TTT)

10586 DETERMINATION OF THE ABSORBED ENERGY IN IRRADIATION OF SUBSTANCES IN NUCLEAR REACTORS BY MEANS OF AN ISOTHERMAL CALORIMETRIC METHOD. C. Salander (Schiffbau und Schiffahrt mbH, Reaktorstation Geesthacht, Ger.). Atomkernenergie, 8: 423-32(Dec. 1963). (In German)

An isothermal calorimetric method for the measurement

of the energy dose absorbed during reactor irradiations of substances is described. The dose values are calculated with respect to the geometrical arrangement from the resulting irradiation temperatures with an absolute error of about 20%, and a relative one of a few percent, especially at high dose rates. An irradiation capsule is described, which had to be constructed because of the required exact geometrical arrangement of the irradiation ampoules. Within this capsule, which was made as variable as possible, the temperature of the ampoules can be controlled by variation of the gas-pressure. Some results obtained with this capsule are discussed and compared with other measurements of the absorbed energy dose. (auth)

10587 EFFECT OF TEMPERING ON STEEL STRUCTURE AFTER ELECTRON BEAM HEATING. V. S. Chernenko (Inst. of Mechanical Engineering, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. RSR, No. 11, 1486-9(1963). (In Ukrainian)

On irradiating IIIX 15 steel with electrons hardening occurred in the surface layer. Closer to the surface the layer consists of martensite and residual austenite. At a certain depth excess carbides were observed in addition to the structural components. On heating up to 100–200°C martensite disintegration occurred only in the layer containing excess carbides; on heating up to 300–500°C it went on throughout the entire irradiated layer. Disintegration of the residual austenite was observed on attaining 500°C, the disintegration products having a higher hardness than the residual austenite. Tempering at 600–700°C led to the formation in the irradiated layer of a disperse ferrito-carbide mixture of the troostite type. Thus, transformations in irradiated steel during tempering are shifted by 100–200°C toward the higher temperatures as compared with the same steel hardened in the conventional way. (auth)

10588 EFFECT OF THE GAMMA IRRADIATION ON THE ELECTRON WORK FUNCTION OF Pt, Au, AND Co METAL SURFACES. S. Minc and J. Siejka (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Electrochim. Acta, 8: 631-7(Aug. 1963).

The influence of γ radiation on the changes of electron work function was investigated in the case of Pt, Au, and Co covered with their own oxide layers. The application of the dynamic condenser method made possible both the irradiation and measurement of the work function in vacuum of the order of 10^{-5} mm Hg. The influence of total dose of gamma radiation on the work function was measured for surfaces of different degrees of oxidation. (auth)

10589 INVESTIGATION OF NEUTRON RADIATION EFFECTS ON IRON PROPERTIES. Sh. Sh. Ibragimov and A. G. Karmilov. Fiz. Metal. i Metalloved., 16: 40-3(July 1963). (In Russian)

Studies of fast neutron bombardment of technical iron showed an increase in hardness and electric conductivity and an expansion of x ray lines (110) and (220) after bombardment at 40 to 70°C. A nonlinear change in lattice parameter as a function of dose was also found. The maximum changes were observed at doses below 3×10^{19} n/cm^2; further exposure does not effect either hardness or electric conductivity. (R.V.J.)

10590 SIMULTANEOUS EFFECTS OF RADIATION AND MERCURY ON MECHANICAL PROPERTIES OF ZINC MONOCRYSTALS. O. A. Troitskii, I. M. Kuleshov, and V. I. Likhtman. Fiz. Metal. i Metalloved., 16: 44-50(July 1963). (In Russian)

Radiation effects of α, β, and γ rays (from Pu^{239}, P^{32}, and Co^{60}) on the mechanical properties of zinc monocrystals coated with mercury were investigated. It is shown that light-particle irradiation (for up to 50 hrs) of uncoated specimens results in considerably stronger crystal relaxation and plasticity. A prolonged exposure (1400 to 1500 hrs) of coated crystals (deformed without irradiation at 20 and −196°C) reduce the strength and elongation caused by mercury diffusion into the zinc surface. (R.V.J.)

10591 RADIATION EFFECTS ON THERMODYNAMICS OF METAL ALLOYS. V. A. Shalashov (All-Union Research Inst. of Mechanical Engineering in Textile and Light Industry, USSR). Fiz. Metal. i Metalloved., 16: 278-84(Aug. 1963). (In Russian)

Fast electron and γ irradiation of white chromium pig irons and their carbide phases intensified the rate of graphitization when chromium content did not exceed ~1%. The thermodynamic activity of carbon in cementite drops to one and the phase becomes stable with ~1.3 to 1.5% Cr. Thermal treatment effects the kinetics of transformation from a metastable to a stable state but does not change the thermodynamics of the states. (R.V.J.)

10592 SURFACE STRUCTURES RESULTING FROM FISSION-FRAGMENT DAMAGE IN LiF CRYSTALS. T. G. Knorr (Battelle Memorial Inst., Columbus, Ohio). J. Appl. Phys., 34: 2767-73(Sept. 1963).

Electron microscopic observation of cleaved LiF crystals bombarded with fission fragments shows that rounded mounds are formed on the surface and have diameters ranging from a few hundred angstroms to 1 micron. Thorough statistical analysis confirms that these mounds are somehow produced as a consequence of the fission fragments that penetrate the crystal; however, ready explanations of their formation are not possible. The mounds have a size distribution that is generally exponential, and contain from 10^6 to as many as 10^9 atoms above the surface of the crystal; neither fact can be explained by current theories of radiation damage. A theory combining mechanical deformation, radiation hardening, and volume diffusion of radiation-produced defects is suggested. (auth)

10593 FISSION-FRAGMENT DAMAGE IN GOLD FILMS. K.L. Merkle, L. R. Singer, and R. K. Hart (Argonne National Lab., Ill.). J. Appl. Phys., 34: 2800-4 (Sept. 1963).

The effects of fission-fragment irradiation on evaporated single-crystalline gold films were studied by transmission electron microscopy. The outstanding feature observed after irradiation is the appearance of black spots of 20 to 300 Å in diameter. These images are diffraction effects caused by damage regions and their surrounding strain field. It is believed that the damage regions are produced by energetic primaries. In some instances the defects could be identified as triangular dislocation loops on (111) planes. Dark-field observations indicate that defects with a compressive as well as defects with a tensile strain field are present. From determinations of the density of spots it is concluded that the average fission fragment produces 25 spots along its path in gold. (auth)

10594 LONG-RANGE CHANNELING EFFECTS IN IRRADIATED CRYSTALS. Christian Lehmann and Guenther Leibfried (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 34: 2821-36(Sept. 1963).

If an energetic atom, a primary, slows down in a lattice, it has the possibility of traveling long distances without essential interaction along almost force-free channels bordered by close-packed atomic chains. This effect was not considered until recently, because, for the sake of simplicity, the lattice was replaced mostly by a corre-

sponding random arrangement. This channeling behavior was found in machine calculations by Robinson, Holmes, and Oen which take the lattice structure into account. The behavior of a primary moving along a channel bordered by the most densely packed directions is investigated analytically. Numerical results are given for a Cu primary moving in a Cu crystal, but the results can easily be extended to other cases. Two potentials are used: an exponentially screened Coulomb potential after Bohr, used also in the machine calculations and thought to give an adequate description for relatively high energies and small interatomic distances; and a purely exponential potential after Born-Mayer, better suited for relatively low energies and large atomic distances. The maximum ranges are very large, for 10 kev in the order of 10^3 lattice parameters for the Born-Mayer potential and up to 10^7 for the Bohr potential. Presumably, the Born-Mayer potential is a better description for these events. The investigation is confined to motions near the channel axis. Therefore, the range distribution near the maximum range is obtained. From an adequate analysis of experimental data on long ranges of primaries, shot onto crystals in low indexed directions, one can obtain information about the potential at distances of about half the lattice spacing. (auth)

10595 Co^{60} γ-RADIATION-INDUCED POINT DEFECTS IN Bi_2Te_3. M. J. Smith (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 34: 2879-84(Sept. 1963).

The effects of extended Co^{60} γ radiation upon the electric resistivity, Hall coefficient, and magneto-resistance of Bi_2Te_3 were examined. Co^{60} γ radiation causes an increase in the Hall coefficient in n-type Bi_2Te_3 and a decrease in p type. For γ-ray exposures in the range of 10^{18} photons cm^{-2}, the apparent carrier removal rate is $\sim 10^{-1}$ carriers per Co^{60} photon. Thermal annealing of radiation-induced damage was also investigated. The results may be most consistently analyzed in terms of a model that consists of radiation-induced tellurium vacancies and interlaminar clusters of Te interstitials. The effects of the radiation-induced point defects are discussed. Evidence of an effect on impurity band conduction at low temperatures in n-type Bi_2Te_3 is observed. (auth)

10596 RADIATION PROPERTIES OF GaAs AND Si SOLAR CELLS. J. J. Wysocki (RCA Labs., Princeton, N. J.). J. Appl. Phys., 34: 2915-17(Sept. 1963).

GaAs and Si solar cells were irradiated with electrons and protons at various energies. The output characteristics of the cells were measured during irradiation. The maximum power output and critical flux were determined. The energy dependence of the results is discussed. (C.E.S.)

10597 TRACKS IN FISSION-FRAGMENT-BOMBARDED LEAD IODIDE. L. T. Chadderton, H. M. Montagu-Pollock, and I. McC. Torrens (Cambridge Univ., Eng.). J. Appl. Phys., 34: 3090-4(Oct. 1963).

The nature of fission-fragment tracks in crystals of lead iodide is sensitively dependent on the thickness of the crystal as well as on the energy, mass, and direction of the incident particle. As the thickness of the specimen is increased the white contrast tracks seen in the electron microscope become discontinuous, and with diffraction contrast they change to tracks that are dark on a lighter ground. At even greater thicknesses no tracks are visible, but only a random array of inclined dislocation loops. Tracks formed from fission fragments arising from thick pieces of uranium foil show branching that is interpreted as due to the registration of knocked-on atoms. Calculations of the rate of energy loss for fragments in lead iodide, made on the basis of a treatment first given by Bohr, are in qualitative agreement with the observations. (auth)

10598 EFFECT OF PENETRATING RADIATION ON THE PERSISTENT INTERNAL POLARIZATION OF CARNAUBA WAX ELECTRETS. Preston V. Murphy, Sergio Costa Ribeiro, Fernando Milanez, and Rogerio J. de Moraes (Universidade Catolica, Rio de Janeiro). J. Appl. Phys., 34: 3138-9(Oct. 1963).

The discharge of the persistent internal polarization of carnauba wax electrets by gamma rays was reported. The residual charge is plotted as a function of dose. High initial depolarization is shown. The temperature dependence shows that depolarization is not a result of radiation heating. It is suggested that the depolarization results from a direct interaction of radiation with the dipolar units. (C.E.S.)

10599 CRYSTALLINITY IN FUSED SILICA INDUCED BY FAST NEUTRON IRRADIATION. S. Weissmann and K. Nakajima (Rutgers Univ., New Brunswick, N. J.). J. Appl. Phys., 34: 3152-3(Oct. 1963).

Fast-neutron irradiated fused silica specimens were studied by the transmission electron diffraction method and the patterns compared with unirradiated control specimens. The crystalline α-quartz pattern was observed only in the very heavily irradiated samples. Specimens irradiated at $(1 - 1.6) \times 10^{19}$ nvt did not show crystalline patterns. Crystalline patterns were observed in specimens irradiated at 8.6×10^{19} to 2.9×10^{20} nvt. (C.E.S.)

10600 PRODUCTION AND DESTRUCTION OF F AND M CENTERS BY X RAYS IN ALKALI HALIDES AT LOW TEMPERATURES. R. F. Wallis and B. J. Faraday (U. S. Naval Research Lab., Washington, D. C.). Phys. Rev., 133: A1360-4(Mar. 2, 1964).

An approximate theoretical analysis is given of the production and destruction of F and M centers by x rays in alkali halides at low temperatures. Kinetic equations describing the time rates of change of F- and M-center concentrations are formulated. Conditions on the kinetic coefficients are established for the validity of the square-law relation between F- and M-center concentrations when the concentration of F centers is not a linear function of x-ray irradiation time. Two mechanisms that lead to a saturation of F-center production are analyzed in some detail. A comparison of theoretical and experimental results leads to information concerning the processes involved in the production and destruction of color centers by x rays. (auth)

10601 F-CENTER PRODUCTION EFFICIENCIES AT LIQUID-HELIUM TEMPERATURE. Victor H. Ritz (U. S. Naval Research Lab., Washington, D. C.). Phys. Rev., 133: A1452-?(Mar. 2, 1964).

The efficiencies for F-center production (ev/F center) were measured at liquid-helium temperature for KBr, KCl, LiF, and NaCl irradiated with 2.0-Mev electrons from a Van de Graaff generator and with x rays from a tungsten-target beryllium-window x-ray tube. Special dosimetric techniques were developed to measure the energy by the samples. The F-center production efficiencies for easily colored alkali halides are typically of the order of 5000 ev/F center for Van de Graaff irradiation, decrease to about 1800 ev/F center for 50-kv x irradiation and then rise again to about 5000 ev/F center for 10-kv x irradiation. NaCl follows the same general trend but is about six times as hard to color. Irradiations of KBr with x rays whose energies are just above or just below the K absorption edge of bromine indicate that the K edge does not play

a dominant role in the coloration process. These results are discussed in relation to proposed mechanisms for the coloration process, and various quantitative and qualitative arguments are presented that indicate that inner shell ionization does not adequately account for either the magnitude of the observed vacancy production or the direction of its energy dependence. A correlation is made between the coloration efficiency and the ionization density along the tracks of the electrons generated by irradiation. It is concluded that mechanisms involving the single ionization of two adjacent halide ions are a more probable cause of the coloration than mechanisms involving either the single ionization of one halide ion or the multiple ionization of one halide ion. A calculation of the yield to be expected for this group of mechanisms is in reasonable agreement with experiment. (auth)

10602 RADIATIVE RECOMBINATION IN GERMANIUM AS AN INDICATOR OF RADIATION DAMAGE. R. Braunstein (RCA Labs., Princeton, N. J.). Solid-State Electron., 6: 349-56(July-Aug. 1963).

It is shown that the radiative recombination of electron-hole pairs from a semiconductor can be used as a monitor of minority-carrier lifetime. By observing the change in the radiative signal under electron-bombardment from n- and p-type germanium for a wide range of majority carrier concentrations, it is shown that a single type of recombination center can account for the minority-carrier lifetime. This level is located at either 0.21 ev from the conduction band or 0.28 ev from the valence band, and has a capture probability for minority holes 24 times that for minority electrons. The technique can be used for the study of radiation damage in other semiconductors where electron-hole radiative recombination has been observed. A prime attribute of the method is that changes in minority-carrier lifetime can be detected in material whose initial lifetime can be of the order of 10^{-10} sec. (auth)

METEOROLOGY

10603 (AEC-tr-6128) PROBLEMS OF NUCLEAR METEOROLOGY. I. L. Karol' and S. G. Malakhov, eds. Translation of "Voprosy Yadernoi Meteorologii" (a publication of the State Publishing House for Literature in the Field of Atomic Science and Engineering, Moscow, 1962). 340p.

Separate abstracts were prepared for the 15 papers presented in this collection. (D.L.C.)

For abstracts of individual papers see: 10277, 10278, 10604, 10605, 10606, 10607, 10608, 10609, 10610, 10611, 10612, 10613, 10614, 10615, and 11029.

10604 (AEC-tr-6128(p.1-51)) THE APPLICATION OF NATURAL RADIOACTIVE ISOTOPES IN THE ATMOSPHERE FOR METEOROLOGICAL STUDIES. I. L. Karol' and S. G. Malakhov. (Translation)

A survey is presented of the meteorological applications of natural radioactive substances located in the atmosphere. The origin of the natural radioisotopes in the atmosphere is discussed. The use of radon and Be^7 for studying large-scale motions of air masses is described. Studies of vertical turbulent mixing in the lower troposphere, aerosol scrubbing in the troposphere, and physics of clouds are also considered. (D.L.C.)

10605 (AEC-tr-6128(p.79-91)) THE MEASUREMENT OF SHORT-LIVED RADIOACTIVE AEROSOLS IN THE FREE ATMOSPHERE. L. V. Kirichenko. (Translation)

The behavior of natural radioactivity in the atmosphere is considered. The difficulties of obtaining the aerosol component of the natural radioactivity are described. An aircraft instrument was developed for taking aerosol samples on a high-efficiency filter and measuring the radioactivity of the aerosol samples immediately after collection. The method of measurements using this instrument is described, and preliminary results obtained in 1957 to 1958 are given. (D.L.C.)

10606 (AEC-tr-6128(p.92-124)) THE VERTICAL DISTRIBUTION OF THE PRODUCTS OF DECAY OF RADON IN THE FREE ATMOSPHERE. L. V. Kirichenko. (Translation)

Results are presented of some aircraft measurements of the natural radioactive aerosols of the atmosphere over Soviet Union in 1956 to 1959. A ground layer was found whose radioactivity increases directly with altitude. The relation between the altitude of this layer and the turbulent diffusion coefficient was demonstrated. Results of cloud-layer measurements show that the radioactivity distribution in the atmosphere depends equally on mixing and accumulation processes and reflects the complex structure of the layer construction of the atmosphere. The growth of short-lived natural aerosols in cloud layers and inversion layers is discussed. (D.L.C.)

10607 (AEC-tr-6128(p.139-82)) MECHANISMS OF CAPTURE AND PRECIPITATION OF ATMOSPHERIC CONTAMINANTS BY CLOUDS AND PRECIPITATION. A. G. Zimin. (Translation)

A review is presented of contemporary physical concepts of the processes of the capture of contaminants by clouds and precipitation. Special attention was paid to the tasks that must be solved to obtain a complete picture of the capture processes. Small, intermediate, and large particles are considered, and the effects of charge were studied. Capture by snow and other types of precipitation is also considered. (D.L.C.)

10608 (AEC-tr-6128(p.183-98)) ON THE SCAVENGING OF THE PRODUCTS OF DECAY OF RADON FROM THE ATMOSPHERE BY RAIN. S. G. Malakhov and L. D. Solodikhina. (Translation)

An experimental study of the radioactivity of precipitation at two different altitudes was conducted in an attempt to obtain the characteristics of the scavenging of radon decay products from atmospheric air by falling raindrops. The scavenging factor was determined to be 4×10^{-5} sec^{-1}, but the reduction in the concentration of decay products in the air during precipitation is insignificant, since decay products are constantly arriving in the atmosphere. The reductions that were observed in a number of cases were due to the reduced exhalation of radon from the soil. The effects of rain intensity on the scavenging were studied. It is concluded that ~30% of the decay products in the rain water was trapped by the process of capture by falling raindrops. The cycle of radon and its decay products between the earth and the atmosphere is discussed. (D.L.C.)

10609 (AEC-tr-6128(p.199-214)) ON THE INFLUENCE OF ATMOSPHERIC PRECIPITATION ON THE RADIOACTIVITY OF THE SURFACE LAYER OF THE ATMOSPHERE. G. V. Dmitrieva. (Translation)

An analysis was conducted on individual examples and statistical data on the radioactivity of the surface layer of air on days with precipitation and on days without precipitation for a number of points in the northern hemisphere. The results show that, while a radioactivity decrease usually occurs on days with precipitation (some increases are observed in the summer months), there is no simple dependence between precipitation and the variation in the radioactivity of the surface layer of air. The possible factors tending to increase the radioactivity after precipitation are discussed. (D.L.C.)

10610 (AEC-tr-6128(p.215-30)) FORMULAS FOR CALCULATING THE TURBULENT DIFFUSION OF A CONTAMINANT SETTLING FROM A POINT SOURCE AND THEIR APPLICATION FOR ANALYSIS OF EXPERIMENTS. N. L. Byzova. (Translation)

Formulas are given for calculating the distribution of a heavy contaminant in the boundary layer of the atmosphere. The determination of meteorological parameters is considered, and the calculations are compared with a few experimental data. A brief survey of available formulas is presented. (D.L.C.)

10611 (AEC-tr-6128(p.231-47)) ON THE ROLE OF TURBULENT SCATTERING ALONG THE DIRECTION OF THE WIND IN A SEMI-EMPIRICAL THEORY OF ATMOSPHERIC TURBULENT DIFFUSTION. I. L. Karol'. (Translation)

In the semi-empirical theory of turbulent diffusion in the atmosphere, the scattering of the contaminant in the direction of the wind is usually ignored. The validity of this assumption is studied by estimating the effect of turbulent diffusion in the wind direction on the distributions of the volumetric and surface concentrations. The case of diffusion of a heterogeneous aerosol is also studied. It is concluded that the effect of turbulent scattering along the wind direction is insignificant at adequately large distances from the source. (D.L.C.)

10612 (AEC-tr-6128(p.248-67)) ON THE INFLUENCE OF VERTICAL TURBULENT DIFFUSION ON THE SUBSIDENCE OF A HETEROGENEOUS AEROSOL FROM THE ATMOSPHERE. I. L. Karol'. (Translation)

A study was made of the qualitative side of the phenomenon of scattering of a polydispersed aerosol by the different rates of gravitational subsidence. The interval of time was determined during which the turbulent diffusion of the polydispersed aerosol from a point source does not depend on the rate K_z of vertical turbulent diffusion. During this time interval, the effect of K_z on the distribution, flow, and density of the contaminant on the ground is negligible when compared to a predetermined error. A dependence was found of this time interval on K_z, source height, and other parameters. (D.L.C.)

10613 (AEC-tr-6128(p.268-300)) THE THEORETICAL EVALUATION OF THE EFFICIENCY OF THE CATCHING OF AEROSOLS BY GUMMED COLLECTORS IN THE SURFACE LAYER OF THE ATMOSPHERE. V. I. Bekoryukov and I. L. Karol'. (Translation)

A qualitative estimate is made of the accumulation of particles absorbed by the surface of gummed collectors. The zone of perturbation of the distribution of the surface concentration of the contaminant is also determined. It is concluded that the assumption of approximate equality of the concentrations of free aerosol and trapped aerosol is valid when the roughness layer is low and turbulent air exchange is weak. (D.L.C.)

10614 (AEC-tr-6128(p.301-5)) ON THE EVALUATION OF THE EFFICIENCY OF THE CATCHING OF AN AEROSOL BY GUMMED COLLECTORS IN THE SURFACE LAYER OF THE ATMOSPHERE. V. I. Bekoryukov. (Translation)

Experiments using artificial colored aerosols were performed to check the results of a theoretical estimate of the degree of accumulation of an aerosol by a gummed collector. The effects of roughness of the underlying surface, atmosphere stratification, wind velocity, and aerosol dimensions on the accumulation were also studied. (D.L.C.)

10615 (AEC-tr-6128(p.306-11)) DIURNAL VARIATIONS IN THE DUST CONTENT OF THE SURFACE LAYER OF THE ATMOSPHERE. K. P. Makhon'ko. (Translation)

To study the secondary process of production of radioactive dust in the air from fallout on the ground, model experiments using gummed collectors 1 m above ground were devised. The diurnal course of the dust content was plotted along with these of wind velocity and vertical turbulent diffusion; all three curves coincide well. The "hysteresis" lag in the dust content with variations in wind velocities and turbulent exchange was studied. (D.L.C.)

10616 SOME DISPERSION EXPERIMENTS PERFORMED BY THE ATOMIC WEAPONS RESEARCH ESTABLISHMENT: A BRIEF SURVEY OF THE TECHNIQUES EMPLOYED AND THE PROBLEMS ENCOUNTERED. D. M. C. Thomas (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Intern. J. Air Water Pollution, 7: 945-52(Dec. 1963).

Experiments to determine the quantity and particle size distribution of materials released in fires and explosions involving certain metals and the subsequent dispersion and deposition of the oxides under various meteorological conditions are described. Problems encountered in air-sampling, deposition, meteorology, and analysis are discussed. (P.C.H.)

10617 ATMOSPHERIC TRACERS AND THE STUDY OF THE GENERAL CIRCULATION OF THE ATMOSPHERE. P. A. Sheppard (Imperial Coll. of Science and Tech., London). Rept. Progr. Phys., 26: 213-67(1963).

The properties of atmospheric tracers, mostly trace substances like water vapor, ozone, and radioactive matter, are discussed. Some of the broad features of the general circulation and its mechanisms are described to provide a background to the knowledge on atmospheric tracers. Its implications are discussed in relation to the circulations in the troposphere and stratosphere and to transfer between these domains. (auth)

PHYSICS

General

10618 (AE-127) A GAS TARGET WITH A TRITIUM GAS HANDLING SYSTEM. B. Holmqvist and T. Wiedling (Aktiebolaget Atomenergi, Stockholm). Dec. 1963. 13p.

A detailed description is given of a simple tritium gas target and its tritium gas filling system, and how to put it into operation. By using the $T(p,n)He^3$ reaction the gas target has been employed for production of monoenergetic fast neutrons of well defined energy and high intensity. The target has been operated successfully for a long time. (auth)

10619 (AFCRL-63-103) INVESTIGATION OF THE ENERGY LEVELS OF MAGNETIC IONS IN THE COMPLEX METAL OXIDES, ESPECIALLY IN THE ORTHOFERRITES. Final Report. Robert L. White (General Telephone and Electronics Labs., Inc., Palo Alto, Calif.). Mar. 28, 1963. Contract AF19(628)-387. 56p. (AD-403785)

The allowed spin configurations in the rare earth orthoferrite were derived on the basis of group theory and correlated with those actually observed. The susceptibilities and antiferromagnetic resonance modes of $YFeO_3$ were calculated. The paramagnetic resonance spectra of Fe^{3+} and Gd^{3+} in $YAlO_3$ were measured and the spectra analyzed to give spin Hamiltonian parameters for these ions. The Fe^{3+} site was found to be nearly cubic, but the Gd^{3+} site was badly distorted. The spin Hamiltonian parameters were compared with crystal fields calculated on a point ion model using positional parameters measured not for $YAlO_3$ but for $GdFeO_3$. Poor agreement was found. Further evidence that the crystal fields are substantially different in the ortho-aluminates from the orthoferrites was obtained in the optical spectrum of Yb^{3+} in $YAlO_3$ and $YbFeO_3$. The $Fe^{3+}-Yb^{3+}$ exchange was observed in the optical spectrum of Yb^{3+} in $YbFeO_3$. The exchange splittings were large, 6 to 10 cm^{-1}, although the Yb^{3+} and Fe^{3+} spins are at nearly right angles, indicating a large antisymmetric exchange. Further studies are suggested to illuminate the orthoferrite magnetic structure. (auth)

10620 (AFCRL-63-610) NON-RADIATIVE ELECTRONIC ENERGY TRANSFER IN ORGANIC LIQUIDS AT HIGH "DONOR" CONCENTRATIONS. Final Report. Sanford Lipsky (Minnesota. Univ., Minneapolis). May 1963. Contract AF19(604)-8356. 33p. (AD-409481)

The efficiency of electronic energy transfer from the liquids benzene, toluene, p-xylene, and mesitylene to p-terphenyl were determined both for uv excitation in the first absorption band and for Cs^{137} gamma excitation. In addition, the efficiency with which oxygen quenches the transport process was determined for both modes of excitation. Both energy transfer and oxygen quenching constants are larger than would be predicted on the basis of a diffusion limited rate. Dilution of the aromatic liquids with hexane reduced the rate of energy transfer. Mechanisms of energy transfer utilizing the states of the bulk solvent are briefly reviewed. Relative scintillation efficiencies were determined for solutions of p-terphenyl in benzene, toluene, p-xylene and mesitylene. The construction of the fluorimeter is described and the emission spectrum of pure liquid benzene presented. (auth)

10621 (ANL-6797) INTERNATIONAL CONFERENCE ON NUCLEAR PHYSICS WITH REACTOR NEUTRONS, OCTOBER 15-17, 1963. A Topical Conference of the American Physical Society. F. E. Throw, ed. (Argonne National Lab., Ill.). Nov. 1963. Contract W-31-109-eng-38. 488p.

The subject matter is divided into five sections: fundamental properties of neutrons, precision measurements of and experiments with capture gamma rays, neutron cross sections, and fission processes. Of the 52 papers presented, separate abstracts were prepared for 43; 9 were previously abstracted in NSA. (R.E.U.)

For abstracts of individual papers see: 10366, 10367, 10368, 10764, 10839, 11137, 11138, 11139, 11140, 11141, 11160, 11161, 11162, 11163, 11164, 11165, 11166, 11167, 11168, 11169, 11170, 11171, 11172, 11173, 11174, 11175, 11176, 11177, 11178, 11179, 11180, 11181, 11182, 11183, 11184, 11185, 11186, 11187, 11188, 11189, 11190, 11191, and 11479.

10622 (CERN-64-3) MAGNET SHIMMING — AN IBM-7090 CODE UTILIZING EMPIRICAL DATA TO OBTAIN OPTIMAL SHIMMING AND TRIMMING OF MAGNETS. Nils Vogt-Nilsen (European Organization for Nuclear Research, Geneva). Jan. 6, 1964. 17p.

A computer program that analyzes previous empirical field data to determine the parameter settings (coils currents, geometrical quantities, etc.) required to give the desired field is described. The method and theory are outlined, and input and output are discussed. (D.C.W.)

10623 (D1-82-0239) ON THE ACCELERATION OF MAGNETOGASDYNAMIC CHANNEL FLOWS THROUGH THE SONIC VELOCITY. F. D. Hains (Boeing Scientific Research Labs., Seattle). Mar. 1963. 82p. (AD-409609)

The possibility of passage through the sonic velocity is examined for the magnetogasdynamic flow through a diverging, straight-walled channel. In addition to the usual assumptions of continuum MGD, the electrical conductivity is assumed to be small; but the effect of Hall current is included. A number of different cases arise, depending on whether or not one or more parameters vanish or are small. Numerical results for the case where the Hall current vanishes and the problem becomes analogous to the gasdynamic source, indicate the sonic point can be placed anywhere along the channel by proper selection of the electric and magnetic field strengths and boundary conditions. (auth)

10624 (HW-79054) PHYSICS RESEARCH QUARTERLY REPORT, JULY-SEPTEMBER 1963. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 15, 1963. Contract AT(45-1)-1350. 97p.

Separate abstracts were prepared for the nine sections of the report. (D.C.W.)

For abstracts of individual sections see: 10376, 11146, 11147, 11196, 11397, 11398, 11435, 11436, and 11482.

10625 (LNF-63/47) RACCOLTA DELLE COMUNICAZIONI PRESENTATE AL CONGRESSINO ANNUALE DELL'-ISTITUTO NAZIONALE DI FISICA NUCLEARE, FRASCATI, 6-7-8-9 MAGGIO 1963. (Compilation of the Papers Presented at the Annual Congress of the Istituto Nazionale di Fisica Nucleare, Frascati, May 6-9, 1963). (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). June 1963. 264p.

Forty-two papers presented at the Annual Congress of the Istituto Nazionale di Fisica Nucleare are compiled. An appendix presents preliminary survey of possible researches with an electron and positron linear accelerator. Separate abstracts were prepared for most of the papers. (J.S.R.)

For abstracts of individual papers see: 10686, 10687, 10688, 10689, 10690, 10691, 10692, 10693, 10854, 10855, 10856, 10857, 10858, 10859, 10860, 10861, 10862, 10863, 10864, 10865, 10866, 10867, 10868, 10869, 10870, 10871, 10872, 10873, 11203, 11204, 11205, 11206, 11207, 11208, 11209, 11210, 11211, 11212, 11213, and 11214.

10626 (NP-13571) NRL QUARTERLY REPORT ON NUCLEAR SCIENCE AND TECHNOLOGY. Progress Report for the Period, April–June 1963. (Naval Research Lab., Washington, D. C.). July 1, 1963. 27p.

Separate abstracts were prepared for six sections of the report. (D.C.W.)

For abstracts of individual sections see: 10219, 10341, 10694, 10695, 10874, and 10875.

10627 (TID-20045) ELECTRON SPIN RESONANCE OF THE R CENTER. D. C. Krupka and R. H. Silsbee (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Jan. 1964. Contract AT(30-1)-2150. 11p.

Van Doorn's model for the R center in the alkali halides, in which three F centers form an equilateral triangle in a (111) plane, is discussed. It is shown that under conditions of low temperature and large applied uniaxial stress, an ESR resonance is produced which supports van Doorn's model. The evidence for the resonance being due to the R center and not some other defect is discussed. (D.L.C.)

10628 (TID-20068) ANNUAL PROGRESS REPORT ON THE RESEARCH PROGRAM IN THEORETICAL PHYSICS AT THE PUPIN LABORATORY. Robert Serber (Columbia Univ., New York). Jan. 15, 1964. Contract AT(30-1)-1934. 14p.

Research progress on field theory, bremsstrahlung, scattering, nuclear theory, perturbation theory, and interactions is summarized. (D.C.W.)

10629 (UCRL-6473(Suppl.I)) ANNOTATED BIBLIOGRAPHY OF THEORIES OF THE EQUATION OF STATE OF HIGH-TEMPERATURE GASES. Stephen G. Brush (California. Univ., Livermore. Lawrence Radiation Lab.). July 3, 1963. Contract W-7405-eng-48. 97p.

First Supplement to UCRL-6473.

References (350) are presented to additional articles on the theory of ionized gases and strong electrolyte solutions. Temperatures down to 2000°K are now covered, and studies of the lowering of the ionization potential in plasma, equilibrium concentrations of ions, and the effects of pair production at very high temperatures are also included. (D.C.W.)

10630 APPROXIMATE SOLUTION TO FLUX CONCENTRATION BY HYDROMAGNETIC FLOW. Jerome M. Baker (Marquardt Corp., Van Nuys, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 112-13(Jan. 1964).

An approximate solution, which is valid for all magnetic Reynolds numbers and in good agreement with previous numerical results for flux concentration by the interaction of a flowing conductor with an applied magnetic field, is presented. (C.E.S.)

10631 MGD SPACE PROPULSION SYSTEM FOR LUNAR MISSIONS. Fred Spindler and Kenneth Wang (Curtiss-Wright Corp., Wood-Ridge, N. J.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 152-3(Jan. 1964).

The mission capability of an MGD propulsion system is investigated, and the advantages in using it for lunar ferry missions are discussed. Compared with either an ion engine or arc-jet engine the MGD propulsion system yields either shorter trip duration or larger payload for equal power/weight ratio. (C.E.S.)

10632 THE MÖSSBAUER EFFECT FOR AN IMPURITY NUCLEUS. I. THEORETICAL RESULTS FOR BRAVAIS CRYSTALS. A. A. Maradudin (Westinghouse Electric Corp., Pittsburgh), P. A. Flinn, and J. M. Radcliffe. Ann. Phys. (N. Y.), 26: 81-114(Jan. 1964).

Formal expressions are derived for the no-phonon, or Mössbauer effect, and one-phonon cross sections for the absorption of a gamma ray photon by an impurity nucleus in an arbitrary Bravais crystal. An expression is also derived for the second order Doppler shift in the energy of the gamma ray. Most of the analysis is carried out on the assumption that the impurity nucleus is a mass defect, but a discussion is also given for the case that the force constants associated with the impurity differ from those for a perfect host crystal. (auth)

10633 RELAXATION EFFECTS IN A SIMPLE MÖSSBAUER MODEL. Harry J. Lipkin (Univ. of Illinois, Urbana). Ann. Phys. (N. Y.), 26: 115-21(Jan. 1964).

The spurious effects that can arise from the neglect of relaxation in simplified calculations of the Mössbauer effect from an impurity source are illustrated by calculations of the Mössbauer effect from an atom bound in an external harmonic potential that is also coupled with a finite relaxation time to a large system in thermal equilibrium. The modification of conventional calculations of the f-factor proposed to include relaxation effects is to take the thermal average of the transition matrix element before squaring it rather than after. (auth)

10634 ADIABATIC INVARIANCE. II. ELLIPTIC MOTION ABOUT A SLOWLY VARYING CENTER OF FORCE. J. E. Littlewood (Trinity Coll., Cambridge, Eng.). Ann. Phys. (N.Y.), 26: 131-56(Jan. 1964).

The approximately elliptic motion of a unit mass under a central force αr^{-2}, where α varies slowly over $-\infty < t < \infty$ and tends to limits $\alpha(\pm\infty)$ as $t \to \pm\infty$ is considered. If $e = e(t)$ is the eccentricity of the momentary orbit at time t and e_0 is that at time $t = 0$, it is assumed that $|e_0| < b < 1$. It is found that subject to appropriate conditions on $\alpha(t)$ and its derivatives, in terms of a measure ϵ of "slowness": e^2 is constant to error $O(\epsilon)$ for all t, the average of e^2 over the local period at time t is constant to error $O(\epsilon^2)$ for all t; and $e^2(\infty) - e^2(-\infty) = O(\epsilon^n)$ for every n. The results are exactly parallel to those found for Lorentz's pendulum, but it is found necessary to consider separately the cases when e_0 is bounded away from 0 and when it is not. The two proofs are quite different, and each is rather complicated. (auth)

10635 ANNUAL REVIEW OF NUCLEAR SCIENCE. VOLUME 13. Emilio Segre, ed. Ann. Rev. Nucl. Sci., 13: 1-590(1963).

Separate abstracts were prepared for the 12 articles in the volume. Numerous references are cited by each author. (R.E.U.)

For abstracts of individual papers see: 9842, 9981, 10281, 10385, 10636, 10637, 10891, 10892, 10893, 11222, 11223, and 11224.

10636 PENETRATION OF PROTONS, ALPHA PARTICLES, AND MESONS. U. Fano (National Bureau of Standards, Washington, D. C.). Ann. Rev. Nucl. Sci., 13: 1-66(1963).

The theory of energy loss, the mean excitation energy, inner shell corrections, energy straggling, multiple scattering effects, and phenomena associated with particle tracks are discussed. Protons, alpha particles, and mesons were chosen because of their penetration dependence on material stopping power. 145 references. (R.E.U.)

10637 PASSAGE OF HEAVY IONS THROUGH MATTER. Lee C. Northcliffe (Yale Univ., New Haven). Ann. Rev. Nucl. Sci., 13: 67-102(1963).

Heavy ions of relatively low atomic number in the region above 10^8 cm/sec are considered. Available theory pertaining to heavy-ion behavior, a survey of experimental data, and a semiempirical correlation of a representative selection of these data are presented. Protons and alpha particles are also considered. 123 references. (R.E.U.)

10638 APPLICATIONS OF THE MÖSSBAUER EFFECT. Atomics, 17: 40-5(Jan.-Feb., 1964).

Various applications of the Mössbauer effect including the gravitational red-shift, detecting the shift in an accelerated system, polarization of resonance radiations from the 14-kev level in Fe^{57}, and others are discussed, and the information that is revealed by Mössbauer absorption-emission is discussed. (R.E.U.)

10639 ABSOLUTE MEASUREMENT OF ACTIVITY OF BETA SOURCE OF LOW SPECIFIC ACTIVITY. H. Gimbergues, Ch. A. Bizollon, and R. Moret (Faculté mixte de Medécine et de Pharmacie, Lyon). Chim. Anal. (Paris), 45: 403-16(Aug. 1963). (In French)

The necessity of correcting the measurements of the beta activity of dense sources is indicated. The principle of the correction for self-absorption is explained, and a method used to determine the coefficient of correction to apply to make an absolute measure of the activity when radiation does not contain electrons of internal conversion is described. The validity of the method is shown in comparing theoretical and experimental values obtained in connection with P^{32}. (tr-auth)

10640 SOME EXACT SOLUTIONS OF THE PLEBANSKI AND PELLEGRIM TETRADE GRAVITATIONAL EQUATIONS. J. Langer (Charles Univ., Prague). Czech. J. Phys., 13: 789-91(1963).

Tetrades are found that satisfy gravitational equations found recently for the case of Peres and Bondi plane gravitational waves. The energy density and energy-current density in these waves are determined. (auth)

10641 DISPERSION RELATIONS AS A CRITERION FOR THE IMAGINARY PART OF A SPECTRAL FUNCTION. V. Šachl. Czech. J. Phys., 13: 792-9(1963).

With the help of the dispersion relation, inequalities are derived as criteria for determining the imaginary part of the spectral function (scattering amplitude, dielectric constant, ...) in the finite interval with a chosen upper limit, on the assumption that the real part of the analytic function at a single point is known. The applicability for measurements of the elastic processes of strong interactions is discussed, and calculations for the imaginary part of the dielectric constant of lead selenide in an experimentally inaccessible region are carried out. (auth)

10642 LINE SCATTERING IMAGES ON ADMIXTURES IN ALKALI-HALIDES. J. Kanturek and K. Suk. Czech. J. Phys., 13: 810-13(1963).

Different types of line scattering images in cubic crystals are discussed, and a method for finding the distribution of rods in the basic substance by means of the scattering image is demonstrated. It is shown that the rods in $NaCl:SrCl_2$ are distributed in all equivalent ⟨141⟩ directions with the same probability. (auth)

10643 CORRECTION FACTOR FOR SELF-ABSORPTION OF FLAT BETA EMITTERS. V. Santholzer (Charles Univ., Hradec Králové, Czechoslovakia). Czech. J. Phys., 13: 822-6(1963).

The self-absorption factor for beta radioactivity of samples of atmospheric fallout, obtained by a large number of measurements, is compared with the theoretical results. Correction curves for fresh atmospheric fallout (up to the age of 1 month), as well as for an older one (an age of 6 to 12 months), were determined. No mathematical expression for self-scattering was derived. For the measuring apparatus in question, it was determined experimentally. (auth)

10644 MOTION OF A CHARGE ALONG A HETEROGENEOUS DIELECTRIC CYLINDER. G. M. Garibyan and R. V. Karapetyan (Erivan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.-Mat. Nauk, 16: No. 5, 99-105(1963). (In Russian)

Calculations were made of the field of a charged particle steadily moving along the axis in a cylindrical dielectric rod surrounded by another dielectric cylinder and placed in a third dielectrical medium. (R.V.J.)

10645 ELECTROMAGNETIC SHOCK WAVES IN GYROMAGNETIC MEDIA. W. B. Hatfield and B. A. Auld (Stanford Univ., Calif.). J. Appl. Phys., 34: 2941-6(Oct. 1963).

The propagation of finite amplitude electromagnetic waves in a gyromagnetic medium is discussed. It is shown, using the method of characteristics, that in the quasistatic or low frequency limit a wave propagating parallel to the external d-c magnetic field distorts continuously until a discontinuity or electromagnetic shock wave appears in the wave profile. When higher-order effects are taken into account, the shock front is found to have a finite width that is reached by a balance between the nonlinear wave-steepening torque term and the wave-broadening loss term. The calculated shock-front width is found to be independent of crystalline anisotropy and exchange and magnetoelastic effects. The theoretical results are compared with numerical calculations, and the possibility of using electromagnetic shock waves in pulse sharpening networks and microwave devices is discussed. (auth)

10646 THE MÖSSBAUER EFFECT AND THE STUDY OF SOLIDS. A. J. Dekker (Rijksuniversiteit, Groningen, Netherlands). Ned. Tijdschr. Naturrk., 29: 25-52(Feb. 1963). (In Dutch)

The use of the Mössbauer effect in the study of solids is indicated by giving a survey of the types of information obtainable. The subjects discussed are a description of the Mössbauer effect, the unsplit spectrum, hfs in the spectrum, quadrupole splitting in the spectrum, and chemical or isomeric displacement of the spectrum. (J.S.R.)

10647 A SPINOR FORMULATION OF ELECTROMAGNETIC THEORY IN GENERAL RELATIVITY. M. Sachs (Boston Univ.). Nuovo Cimento (10), 31: 98-112(Jan. 1, 1964).

The spinor formulation of the Maxwell-Lorentz theory that was developed earlier is extended to a generally covariant formalism. The underlying group for electro-

dynamics is thereby generalized from the proper inhomogeneous Lorentz group L_p to a special topological group T. It follows from the physical assumptions of this theory that the group T must be locally compact, connected, and satisfy the second axiom of countability. The invariants and conservation laws of the generalized theory are derived and a correspondence of some of them with those of the conventional theory is demonstrated. The remaining invariants and conservation laws have no counterpart within the usual formalism. Extra terms that appear are due to the spin-affine connection field and the invariants that do not conserve reflection symmetry in space and time. Within this generalized formalism, the uniqueness of earlier derived results of a generalized Lorentz covariant theory of electromagnetism is demonstrated. The Lagrangian density for the present formulation is derived and the role that is played by a fundamental length, which is inherent in the theory, is discussed. (auth)

10648 STABILITY OF ALKALI HALIDE CRYSTALS IN TERMS OF MANY-BODY INTERACTIONS. Laurens Jansen and Erminio Lombardi (Battelle Memorial Inst., Geneva). Phys. Rev. Letters, 12: 11-14(Jan. 6, 1964).

First- and second-order perturbation calculations of the energy of interaction were carried out for triplets of atoms or ions in rare-gas solids, since alkali halide ions are isoelectronic, for three-body exchange interactions with two atoms or ions as nearest neighbors of the third, to determine the three-body-interaction stabilizing effect on alkali halide crystals. A Gaussian effective-electron charge configuration is used for the ions of the alkali halide crystals. Results are given for cesium chloride, sodium chloride, cesium iodide, and rubidium chloride. (R.E.U.)

10649 EFFECT OF PRESSURE ON THE RESISTANCE OF CESIUM. R. A. Stager and H. G. Drickamer (Univ. of Illinois, Urbana). Phys. Rev. Letters, 12: 19-20(Jan. 6, 1964).

Discontinuities in resistance and volume were studied for 99.95% pure cesium at 296°K at 0 to 500 kilobars. The mode of volume change by band promotion of electrons is discussed. (R.E.U.)

10650 NUCLEAR MAGNETIC RESONANCE OF Gd^{155} AND Gd^{157} IN THE CUBIC FERROMAGNET GdN. E. L. Boyd and R. J. Gambino (IBM Watson Research Center, Yorktown Heights, N. Y.). Phys. Rev. Letters, 12: 20-1 (Jan. 6, 1964).

The preparation of the host lattice GdN with rock salt structure is described. The line shapes and NMR frequencies are discussed. (R.E.U.)

10651 PRESSURE-INDUCED PHASE TRANSFORMATION IN GADOLINIUM AND ITS EFFECT ON THE MAGNETIC BEHAVIOR. A. Jayaraman and R. C. Sherwood (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Letters, 12: 22-3(Jan. 6, 1964).

The pressure-induced transformation of hcp gadolinium to the samarium-type structure, metastably retained at room temperature under atmospheric pressure, and the magnetic behavior of the phases are reported. X-ray-powder photographic data are given. (R.E.U.)

10652 MODEL FOR RADIATION EQUILIBRIUM BETWEEN F AND M CENTERS IN KCl. J. H. Crawford, Jr. (Oak Ridge National Lab., Tenn.). Phys. Rev. Letters, 12: 28-30(Jan. 6, 1964).

A kinetic model is introduced to account for the F- and M-center equilibrium in KCl. The model includes electron capture by F centers producing mobile F′ centers, which migrate to neighboring F centers and anion vacancies to form M centers. Hole capture by M centers then releases enough energy to cause dissociation in anion centers that upon electron capture become F centers. Approximate differential equations are given. (R.E.U.)

10653 FARADAY ROTATION FOR THE F BAND IN KCl. F. Luety and J. Mort (Univ. of Illinois, Urbana). Phys. Rev. Letters, 12: 45-7(Jan. 13, 1964).

The Faraday rotation was measured in uncolored and colored KCl crystals using a dynamical method. The plane polarized light from a monochromator is focused on the sample that is at the center of a 50-kilogauss superconducting solenoid in a liquid helium Dewar. The transmitted light passes through a rotating polarizer and is detected by a photomultiplier. The resulting alternating signal is compared with a reference signal using an amplitude-independent phase meter, and any change in the plane of polarization is observed as a phase shift. (R.E.U.)

10654 ON THE YANG-LEE DISTRIBUTION OF ROOTS. E. Hiis Hauge and P. C. Hemmer (Norges Tekniske Hoegskole, Trondheim, Norway). Physica, 29: 1338-44(Dec. 1963).

The Yang-Lee distribution of roots for two examples of repulsive potentials, viz., one-dimensional hard rods and weak long range repulsion, is calculated. In both cases the root distribution is located on part of the negative real axis. (auth)

10655 REPORTS ON PROGRESS IN PHYSICS. VOLUME XXVI. A. C. Stickland, ed. The Institute of Physics and The Physical Society. Rept. Progr. Phys., 26: 1-472 (1963). London, The Institute of Physics and the Physical Society, 1963. 474p.

Separate abstracts have been prepared for 6 of the 11 papers included; one paper was previously abstracted in NSA. Those papers not abstracted separately consider the preparation and behavior of nearly perfect metal surfaces, x-ray crystallograph of large biological molecules, wavelength measurements in the vacuum ultraviolet, and ultra-high-speed photography. (R.E.U.)

For abstracts of individual papers see: 10564, 10617, 10656, 10657, 10658, and 10817.

10656 LATTICE VIBRATIONS. W. Cochran (Cambridge Univ., Eng.). Rept. Progr. Phys., 26: 1-45(1963).

The theory of lattice dynamics in the harmonic approximation is due mainly to Born and his collaborators. The application of the theory to molecular, metallic, ionic, and covalent crystals is outlined, showing the position as it was about seven years ago. Since then the improvement of an existing experimental technique (the thermal diffuse scattering of x rays), and the development of a new one (the spectroscopy of thermally scattered neutrons), have given new detailed information about the normal modes of vibration of crystals. This has stimulated fresh interest in the theory and has given new information about interatomic forces in crystals. While the essential features of Born's theory have survived, requiring so far only minor amendments for ionic and covalent crystals, it is becoming clear that for metals a somewhat different approach is required. (auth)

10657 THE GENERATION OF HIGH MAGNETIC FIELDS. D. Bruce Montgomery (Massachusetts Inst. of Tech., Cambridge). Rept. Progr. Phys., 26: 69-104(1963).

The generation of high magnetic fields by means of water-cooled magnets, iron magnets, pulsed magnets, cryogenic magnets, and superconducting magnets is discussed. Relations between currents, fields, power, mag-

netic stresses, cooling requirements, and field homogeneity are presented. Fabrication techniques, power supplies, and specific magnet constructions are discussed. Reference is made to nearly 100 papers giving more detail on specific subjects. (auth)

10658 MACROSCOPIC SYMMETRY IN SPACE-TIME. R. R. Birss (Imperial Coll. of Science and Tech., London). Rept. Progr. Phys., 26: 307-360(1963).

Magnetic and nonmagnetic crystallographic point groups may be distinguished by the different relations in which they stand to the time-inversion or anti-identity operator R. The 32 point groups of classical crystallography G may be used to generate both magnetic and nonmagnetic groups. A nonmagnetic group G′ is generated by the generators of any G together with the operator R. There are therefore 32 groups G′, each with twice as many elements as the corresponding group G. The 90 magnetic groups, M′, comprise the 32 classical crystallographic groups, G, and 58 additional groups, M, which contain R only in combination with elements other than the identity operator. The classical point groups, G, are considered and the crystallographic symmetry operators are discussed and tabulated for the various crystal classes. The connection between the symmetry operators and the symmetry of macroscopic property tensors is examined and this connection is formalized by the use of generating matrices. By way of example, the evaluation of the form of a particular tensor in one of the hexagonal crystal classes is discussed. The extension to the general case is considered and a table is presented that displays the equalities between the forms of property tensors in the various crystal classes. This is augmented by another table showing the specific forms of tensors of ranks 0, 1, 2, 3, and 4 for the various point groups G. The additional restrictions imposed on property tensors by particularization and otherwise are discussed and a consideration of null property tensors and "forbidden" effects, is included. After an introductory discussion of time-inversion, the concepts of elementary group theory are used to show how the magnetic groups M′ may be derived from the classical crystallographic groups G. The symmetry operators and generating matrices of each group M′ are tabulated and the influence of the new symmetry operators on the symmetry of property tensors is examined. The results of this examination are embodied in a table that permits the form of any property tensor in any magnetic group (M′) to be obtained from the corresponding result for a classical group (G). The tensor components are tabulated explicitly for tensors of ranks 0, 1, 2, 3, and 4, so that the form of any such tensor may be obtained immediately both for magnetic and nonmagnetic classes. The use of these tables is exemplified by considering static physical effects that are peculiar to magnetic crystal classes. Pyromagnetism and the magnetoelectric effect are taken as examples of tensors of the first and second rank respectively. Piezomagnetism provides an example of a third-rank tensor and also illustrates the simplifying effect of particularization. A discussion of the application of symmetry considerations to dynamic properties such as transport phenomena is presented. Experimental data on "forbidden" effects in antiferromagnetic materials are presented, and the experimental observations are correlated with predictions. The magnetic properties of ferromagnetic and ferrimagnetic crystals are discussed separately. An alternative method of obtaining the forms of property tensors is mentioned. (auth)

10659 PRODUCTION OF SHORT PROTON PULSES BY DOUBLE-PHASE FOCUSING. Eberhard Wunderer (Technische Hochschule, Munich). Z. Angew. Phys., 16: 285-9(Nov. 1963). (In German)

Short, high-current proton pulses of high following frequency should be produced for introduction into an h-f resonance accelerator. The proton continuous current produced by the source was velocity modulated with sinusoidal h-f voltages and converged in adjourning field-free space. By double application of the velocity modulation in phase-locked coupled h-f fields with frequencies at 1.67 and 20 MHz, a pulse half life of 8.8 ± 0.5 nsec was obtained. (tr-auth)

10660 SOME THEORETICAL CONSIDERATIONS OF THE MÖSSBAUER EFFECT. F. C. Whitmore (Southwest Research Inst., San Antonio, Tex.). p.136-45 of "Proceedings of the Symposium on Physics and Nondestructive Testing." San Antonio, Texas, Southwest Research Institute, 1963.

The basic physical processes associated with the recoilless emission of gamma rays are discussed. The apparatus required to observe the effect is described. (R.E.U.)

10661 LEHRBUCH DER KERNPHYSIK. BAND I. EXPERIMENTELLE VERFAHREN. (Text Book on Nuclear Physics. Vol. I. Experimental Methods). G. Hertz. Leipzig, B. G. Teubner Verlagsgesellschaft, 1958. 227p.

The experimental methods in nuclear physics are considered. As an introduction the electron and photon, the electron shells of the atom, the properties of stable atomic nuclei, and the transformation of atomic nuclei are discussed. Methods of determining nuclear charge, nuclear radius, nuclear mass, and nuclear moments are described. Detection of energetic radiation by observation of ionization current, by effects of radiation on material, and by using radiation counters, electronic equipment, and spectrometers is discussed. The development and uses of particle accelerators are reviewed. (M.C.G.)

10662 LEHRBUCH DER KERNPHYSIK. BAND II. PHYSIK DER ATOMKERNE. (Text Book on Nuclear Physics. Vol. II. Physics of Atomic Nuclei). G. Hertz. Leipzig, B. G. Teubner Verlagsgesellschaft, 1960. 914p.

Physics of the atomic nucleus is considered. The properties of stable nuclei are given. Nuclear transformations are discussed, including radioactive decay, spontaneous nuclear transformation, nuclear reactions, nuclear fission, and nuclear processes at extremely high energies. Theories of nuclear reactions are outlined. Theories of the nucleus are reviewed. Neutron physics is discussed. The following tables are included: charge eigenfunctions; resonance frequencies and diamagnetic corrections to the magnetic dipole moments; nuclear moments and shell-model configurations; Nilsson scheme; review of elementary particles; mass values, abundance, and nuclear moments of stable and some long-lived unstable nuclei; unstable nuclei; important constants in atomic physics; conversion factors and equivalence designations; chemical atomic weights; and periodic system of elements. (M.C.G.)

10663 PROCEEDINGS OF THE INTERNATIONAL SCHOOL OF PHYSICS "ENRICO FERMI." COURSE XX. EVIDENCE FOR GRAVITATIONAL THEORIES. VARENNA ON LAKE COMO. VILLA MONASTERO. JUNE 19–JULY 1, 1961. C. Moeller, ed. New York, Academic Press. 1962. 269p.

Separate abstracts were prepared for 12 of the 13 lectures presented; the remaining lecture is on human color perception. (R.E.U.)

For abstracts of individual lectures see: 10664, 10665, 10666, 10667, 10668, 10669, 10670, 10671, 10672, 10673, 10674, and 10759.

10664 MACH'S PRINCIPLE AND EQUIVALENCE. R. H. Dicke (Princeton Univ., N. J.). p.1-49 of "Evidence for Gravitational Theories." New York, Academic Press, 1962.

An interpretation of Mach's principle is discussed where the gravitational constant measured locally is dependent on the mass distribution in the universe. The decrease with time of the gravitational constant, as a result of expansion of the universe, is shown to have many implications for astronomy, biology, and geology. 37 references. (R.E.U.)

10665 REVIEW OF JORDAN'S EXTENDED THEORY OF GRAVITATION. D. R. Brill (Universität, Hamburg). p.50-68 of "Evidence for Gravitational Theories." New York, Academic Press, 1962.

The Dirac hypothesis based on the three "Eddington numbers," which describe fundamental properties of elementary particles and of the universe, and its ability to predict the time variation of the gravitational constant (G) are discussed. The four-dimensional theory developed by Jordan from the Kaluza–Klein five-dimensional unified theory of gravitation and electromagnetism is discussed in its interpretation as G. The field equations obtained from the variational principles formed from the variables in Jordan's theory are discussed, and some explicit solutions are given. The application of Jordan's theory to cosmology is discussed. (R.E.U.)

10666 GRAVITATIONAL THEORIES OF THE WHITEHEAD TYPE AND THE PRINCIPLE OF EQUIVALENCE. A. Schild (Univ. of Texas, Austin and Dublin Inst. for Advanced Studies). p.69-115 of "Evidence for Gravitational Theories." New York, Academic Press, 1962.

Whitehead's action-at-a-distance theory of gravitation in the flat Minkowski space-time of special relativity is discussed. A variant of Whitehead's theory, which admits conservation laws for the total linear and angular momenta of a system of gravitating particles that interact through retarded gravitational tensor potentials, is presented. The rotation of the perihelion of planetary orbits, the gravitational redshift, and the bending of light in general relativity are considered, and the incompleteness of Whitehead's theory is pointed out. Whitehead-type theories are compared to gravitational theories in curved space-time and it is shown that flat space-time theories cannot satisfy the principle of equivalence or predict the usual gravitational redshift. (R.E.U.)

10667 THEORY OF METHODS FOR MEASUREMENT AND PRODUCTION OF GRAVITATIONAL WAVES. J. Weber (Univ. of Maryland, College Park). p.116-40 of "Evidence for Gravitational Theories." New York, Academic Press, 1962.

Theoretically assumed gravitational waves are discussed. The detection and measurement of dynamical gravitational fields and laboratory generation of gravitational waves are discussed. (R.E.U.)

10668 COSMOLOGICAL TESTS OF GRAVITATIONAL THEORIES. F. Hoyle (Cambridge Univ., Eng.). p.141-73 of "Evidence for Gravitational Theories." New York, Academic Press, 1962.

Cosmological kinematics, cosmological dynamics based on Einstein's theory and on steady-state theory, and observational tests in cosmology are discussed. (R.E.U.)

10669 THE THEORY OF MEASUREMENT IN GENERAL RELATIVITY. B. Bertotti (Princeton Univ., N. J.). p.174-201 of "Evidence for Gravitational Theories." New York, Academic Press, 1962.

Quantum limitations on the measurements of the gravitational field over a single region of space-time are considered. Invariance, local measurements, inertia, rotation, sidereal and ephemeris times, and astronomial rotation are discussed. 43 references. (R.E.U.)

10670 GRAVITATIONAL WAVES. H. Bondi (King's Coll., London). p.202-7 of "Evidence for Gravitational Theories." New York, Academic Press, 1962.

An expansion of $1/r$, where r is a suitably defined radius, is considered as an asymptotic solution of the empty-space Einstein equation for an isolated gravitational system with a radiation field. A consistent solution with axial symmetry that contains an arbitrary function of time as the news function is obtained. The specification of the physical situation is given by one function on an initial null cone with the news function in the future. Any time-dependence of the news function leads to radiation of energy that shows up as a decrease in the mass of the system. Nonradiative time-dependent motions appear to exist. (R.E.U.)

10671 THE MÖSSBAUER EFFECT AND EXPERIMENTS IN RELATIVITY. T. E. Cranshaw (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.208-21 of "Evidence for Gravitational Theories." New York, Academic Press, 1962.

The use of the Mössbauer effect for measuring the frequency shifts $\delta\varphi/c^2$, where φ is the gravitational potential, and the shift $\frac{1}{2}\,v^2/c^2$, the so-called second-order Doppler effect or the transverse Doppler effect, is discussed. The two shifts are linked by Einstein's Equivalence Principle, which states that for all experiments, a gravitational field is entirely equivalent to an accelerated frame. The first-order Doppler effect is made zero by placing the radiation source and observer on the same rigid piece of metal. (R.E.U.)

10672 OUTLINE OF W. THIRRING'S ALTERNATIVE APPROACH TO THE THEORY OF GRAVITATION. R. Sexl (Universität, Vienna). p.228-32 of "Evidence for Gravitational Theories." New York, Academic Press, 1962.

A tensor theory is used to describe gravitation. Gauge invariance of the field equations forced the introduction of a Riemannian metric as the real physical one, because neither the original flat metric nor the motion of the particles in it were gauge invariant. After arriving at these general co-ordinate transformations, Riemannian geometry is used to make the theory consistent in all orders of the coupling constant. The result is Einstein's gravitation theory. (R.E.U.)

10673 A THEORY OF GRAVITATION. H. Yilmaz (Sylvania Electric Products, Inc., Waltham, Mass.). p.233-51 of "Evidence for Gravitational Theories." New York, Academic Press, 1962.

A generally covariant scalar field theory of gravitation is presented that leads to isotropic solutions in a natural manner. The theory predicts correctly the three crucial tests of the Einstein theory and also leads to a finite self-energy for the field of a point particle. The solutions are harmonic in the sense of Fock. (R.E.U.)

10674 TETRAD FIELDS AND CONSERVATION LAWS IN GENERAL RELATIVITY. C. Moeller (Universitetets Institut for Teoretisk Fysik and NORDITA, Copenhagen). p.252-64 of "Evidence for Gravitational Theories." New York, Academic Press, 1962.

The conditions that the energy-momentum complex has to satisfy for a description of energy and momentum of a system including its gravitational field in general relativity are discussed. Representation of gravitational fields by means of tetrads is shown to satisfy the conditions. (R.E.U.)

10675 DTA AND MÖSSBAUER STUDIES IN RARE EARTH ORTHOFERRITES. M. Eibschuetz, G. Gorodetsky, S. Shtrikman, and D. Treves (Weizmann Inst. of Science, Rehovoth, Israel). 8p. (CONF-342-12)

From Conference on Magnetism and Materials, Atlantic City, Nov. 1963.

Curie temperatures of 14 different orthoferrites with the chemical formula $RFeO_3$ (R = Y, La, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu) were measured by differential thermal analysis. Hyperfine interactions of the Fe^{57} nucleus in the same materials were determined from their Mössbauer spectra. It is found that the quadrupole splitting, with the exception of the case of Sm, isomer shift, Curie temperature, and internal field vary regularly with the ionic size of R. (auth)

10676 EPR OF EXCHANGE-COUPLED PAIRS OF Eu^{2+} IN CaO AND SrO. B. A. Calhoun and J. Overmeyer (International Business Machines Corp., Yorktown Heights, N. Y.). 9p. (CONF-342-14)

From Conference on Magnetism and Materials, Atlantic City, Nov. 1963.

The EPR spectra of isolated Eu^{2+} ions were studied in crystals of CaO and SrO. In SrO, there is no crystal field splitting of the $S_{\frac{7}{2}}^{8}$ level of the Eu^{2+}. The g-values and hyperfine constants are the same in both crystals. Crystals of CaO and SrO containing 1 to 2% Eu exhibit in addition a large number of weak lines at both lower and higher fields than the single ion spectra observed in more lightly doped crystals. These resonances arise from coupled pairs of Eu^{2+} ions, and their analysis provides direct information about the exchange interactions between the Eu^{2+} ions. The temperature dependence of these intensities shows that the nearest-neighbor exchange interaction is ferromagnetic and its magnitude is approximately 1°. In the [100] direction, some of the resonances due to next nearest neighbor pairs were identified. (auth)

Accelerators

10677 (BNL-7674) A SUMMARY OF THE COSMOTRON EXPERIMENTS ON THE COHERENT VERTICAL INSTABILITY. M. Q. Barton, G. W. Bennett, J. G. Cottingham, A. J. Enright, J. W. Glenn, J. L. Harris, G. H. Morgan, L. W. Smith, A. Tranis, and R. J. Warkentien (Brookhaven National Lab., Upton, N. Y.). Nov. 27, 1963. Contract [AT(30-2)-Gen-16]. 9p.

Coherent vertical betatron oscillations leading to beam losses were identified in the Cosmotron. The intensity dependence of the oscillation growth rate and the dependence of the oscillation frequency on intensity and radius were investigated. Evidence for a radial instability was also obtained. Recently, the vertical instability was successfully damped by electronic circuits. (D.C.W.)

10678 (BNL-7700) MAGNETIC MEASUREMENTS OF AGS EXPERIMENTAL BEAM QUADRUPOLES. Internal Report. Gordon T. Danby and John W. Jackson (Brookhaven National Lab., Upton, N. Y.). Dec. 2, 1963. Contract AT(30-2)-Gen-16. 25p.

The results of magnetic measurements on circular and rectangular quadrupoles are presented. For the circular quadrupoles sufficient data are given to permit treatment of the nonlinearities in the thicks lens approximation. The data for the rectangular quadrupoles permits a complete expansion of the field in terms of symmetrically allowed nonlinearities. (D.C.W.)

10679 (BNL-7706) POSSIBLE HANDLING METHODS FOR RADIOACTIVATED ACCELERATOR COMPONENTS. Carl R. Flatau (Brookhaven National Lab., Upton, N. Y.). Dec. 20, 1963. Contract [AT(30-2)-Gen-16]. 11p.

The requirements for a remote handling system for a large accelerator with high levels of induced radioactivity are formulated, using the Brookhaven Alternating-Gradient Synchrotron as a model. Some possible manipulating systems are discussed, together with the adaptation of accelerator components to manipulator handling. Cost estimates are included. (D.C.W.)

10680 (BNL-7719) BEAM II PROGRAM. Jack Sandweiss and James R. Sanford (Brookhaven National Lab., Upton, N. Y.). Nov. 1959. Contract [AT(30-2)-Gen-16]. 23p.

The BEAM II for charged particle beam design is described. It traces rays, representing such particles, through free spaces (F), quadrupole magnetic fields (Q), uniform magnetic fields with parallel boundaries (M), and gradient magnetic fields (G). BEAM II sets up the equations for the transformation through a F, Q, M or G space, performs the indicated mathematics, prints out positions of the ray after each space, and then moves on to the next space. BEAM II permits consideration of F, G, M or G spaces in any order, thus allowing easy mock-up of various beam arrangements. By a systematic variation of the parameters characterizing a beam arrangement the beam can be brought to a focus, its dispersion determined, and some aberrations of the system investigated. (auth)

10681 (CEAL-1009) SEMI-ANNUAL REPORT [ON ELECTRON ACCELERATOR], JULY 1–DECEMBER 31, 1963. (Cambridge Electron Accelerator, Mass.). Jan. 17, 1964. Contract AT(30-1)-2076. 12p.

Research progress on pair production, photoproduction, beta scattering by protons and deuterons, meson (π) production, shielding, polarized photon production, and photon-proton scattering is reported. Developments of experimental equipment and facilities are also summarized, together with accelerator improvements and operation. (D.C.W.)

10682 (IKF-7) AUFBAU UND INSTALLATION DES 1.5 Mev- UND DES 6 Mev-IONENBESCHLEUNIGERS DES IKF. (Installation of the Electrostatic Ion Accelerators at the Institut fur Kernphysik, Frankfurt). P. Kleinheins (Johann-Wolfgang-Goethe-Universität, Frankfurt am Main. Institut für Kernphysik). May 1963. 78p.

A 1.3-Mev Cockcroft-Walton accelerator (open cascade) and a 6-Mev Van de Graaff accelerator were installed in a common building with target rooms below ground level. The layout of the building is described, together with the arrangement of the accelerators, the radiation shielding, safety devices and auxiliary equipment, such as electrical installations, cooling water supplies, refrigeration systems, pressure gas system and auxiliary units. (auth)

10683 (JINR-P-1448) RASCHET NACHAL'NOI OBLASTI USTOICHIVYKH FAZOVYKH KOLEBANII V SINKHROTSIKLOTRONE. (A Calculation of the Initial Region of the Stable Phase Oscillations in the Synchrocyclotron). V. I. Danilov, I. B. Enchevich, D. L. Novikov, E. A. Pol-

ferov, A. N. Safonov, and B. V. Feoktistov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1963. 25p.

In order to find the possibilities of increasing further the current of the accelerated protons in the synchrocyclotron, a more accurate quantitative calculation of the efficiency of capture into the stable radial-phase oscillations was made. The calculation was based on the analysis of the radial-phase ion trajectories in the central region of the synchrocyclotron. The trajectories, in their turn, were obtained just from the solutions of the equations for the ion motion in the electromagnetic field. The capture regions were determined as a function of the synchrocyclotron parameters: the dee aperture, the amplitude of the accelerating voltage, the gradient of the magnetic field, and the rate of change of the accelerating voltage frequency. A mechanism for formation of the accelerated ion beam in the initial region of acceleration was obtained. (auth)

10684 (JINR-P-1449) DEPOLYARIZATSIYA CHASTITS PRI USKORENII V SINKHROTSIKLOTRONE. (Particle Depolarization in Acceleration in a Synchrocyclotron). Yu. A. Plis and L. M. Soroko (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1963. 23p.

The resonance depolarization of protons and deuterons accelerating in the synchrocyclotron of the Laboratory of Nuclear Problems was investigated. The main effect in proton acceleration is due to the second and the third harmonics of the median plane distortion. The resonance orbit radii are 95 and 260 cm, respectively. It was shown that polarization is conserved. In the calculation of the depolarization, the effect of phase oscillations and the fringing magnetic field in extraction were taken into account. In deuteron acceleration the vertical oscillations are responsible for the resonance. The depolarization amounts to 30%, and the only way to conserve polarization is to decrease the amplitude of free vertical oscillations. (auth)

10685 (JINR-P-1488) IZMERITEL' KOEFFITSIENTA BEGUSHCHEI VOGNY. (A Device for the Travelling-Wave Ratio Measurement). A. A. Glazov and M. M. Semenov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1963. 6p.

A device using directional couplers, is described for measuring the travelling-wave ratio in a coaxial feeder. A direct division of the two input voltages is employed The device was used for matching a 50-ohm transmission line with an analogue of the r-f accelerating system of the 700-Mev relativistic cyclotron. The operating frequency is 12 Mc/sec. The accuracy of measurements is 5 ± 7%. (auth)

10686 (LNF-63/47(p.133-9)) RISULTAI DELLE MISURE CON ADA AD ORSAY. (Results of Measurements with AdA at Orsay). C. Bernardini, G. F. Corazza, G. Di Giugno, G. Ghigo, J. Haissinski, P. Marin (Paris. Université, Orsay. École Normale Supérieure. Laboratoire de l'Accélérateur Linéaire); R. Querzoli, and B. Touschek (Italy. Istituto Nazionale de Fisica Nucleare, Rome).

In June 1962 the AdA accumulation ring for e^+e^- beams of ≤250 Mev was transferred from Frascati to Orsay. The injection method used was essentially the same as that used at Frascati with a variation on the method used for the transition from positron injection to electron injection. The improvement obtained in the injection velocity from the use of the Orsay Linac is illustrated. The experimental configuration used for the detection of the gamma rays from the process $e^+ + e^- \rightarrow \gamma + \gamma$ is given, and the preliminary results, which do not agree with those predicted, are reported. (J.S.R.)

10687 (LNF-63/47(p.139-42)) LIFETIME AND BEAM SIZE IN A STORAGE RING. C. Bernardini, G. F. Corazza, G. Di Giugno, G. Ghigo, J. Haissinski, P. Marin (Paris. Universite, Orsay. École Normale Supérieure. Laboratoire de l'Accélérateur Linéaire); R. Querzoli, and B. Touschek (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

Measurements of the lifetime of stored beams made with the Frascati e^+e^- storage ring at Orsay are reported. The lifetime τ depends on the number N of particles in the beam and can be expressed by $1/\tau = \alpha(E)N + 1/\tau_0$, where $\alpha(E)$ is a strongly energy-dependent parameter. The lifetime of a given beam is independent of the presence of the other. A theoretical explanation of this effect is given, which suggests that the actual volume of the bunches is considerably larger than the natural one. (J.S.R.)

10688 (LNF-63/47(p.142-57)) STATO DI AVANZAMENTO DEL PROGETTO "ADONE." (State of Design of the "Adone" Project). F. Amman, R. Andreani, M. Bassetti, et al.

During 1962 and the first months of 1963 the work on the Adone project was devoted to detailed designs of various parts of the machine and model studies of the principal components. The theory of the device is discussed, and then the design principles of the injector, pulsed deflector, magnets, and flight space and cameras are described. The characteristics of the Adone are tabulated. (J.S.R.)

10689 (LNF-63/47(p.160-9)) NANOSECOND TIME-OF-FLIGHT AND PHOTONEUTRON POLARIZATION MEASUREMENTS WITH AN ELECTRON LINEAR ACCELERATOR. W. Bertozzi, P. T. Demos, S. Kowalski, C. P. Sargent, and W. Turchinetz.

The development of techniques for pulsing a linac for nanosecond intervals and for measuring the energy of photoneutrons by time-of-flight with nanosecond timing has been the object of concentrated study by a group at MIT. These techniques were used successfully for neutron energies greater than 10 kev. The set-up for the linac and the time-of-flight measurements is shown, and the measurement techniques are discussed. Among the experimental results described are measurement of the $C^{13}(\gamma,n)C^{12}_0$, $Be^9(\gamma,n)Be^8_0$, $Be^9(\gamma,n)Be^8$ (2^+ state), and $He^4 + He^4 + n$ cross sections. Time-of-flight measurements on photoneutrons from natural lead with 8-Mev bremsstrahlung were made to illustrate the technique at lower energies. The measurement of the polarization of neutrons from $D(\gamma,n)p$ at 90° to the photon beam from 8 to 30 Mev is described in some detail. (J.S.R.)

10690 (LNF-63/47(p.175-81)) BREMSSTRAHLUNG COERENTE DALL'ACCELERATORE LINEARE DA 400 Mev. (Coherent Bremsstahlung of the Linear Accelerator at 400 Mev). G. Barbiellini, G. Bologna, G. Diambrini, and G. P. Murtas (Italy. Comitato Nazionale per l'Energie Nucleare. Laboratori Nazionali, Frascati).

The problem of the calculation of the coherent bremsstrahlung is illustrated, and typical results of the bremsstrahlung of a beam of parallel electrons which hit a point zone on an infinitely thin diamond at an angle to the [110] axis are graphed. The comparison of the collimated and noncollimated beam shows that the effect of collimation is the isolation of the "line" in the spectrum and the decrease of the continuous background. It is shown that the undesirable line can be eliminated by a measurement of the difference of two spectra in which the primary lines

cancel each other. The evaluation of the order of magnitude of the number of photons under the conditions E = 400 Mev, θ = 10.4 mrad, and U_θ = 0.35 gave the value $N_\gamma = 10^9$ photons/sec. (J.S.R.)

10691 (LNF-63/47(p.219-39)) UTILISATIONS DES ACCELERATEURS LINEAIRES POUR DES EXPERIENCES DE PHYSIQUE DU NEUTRON A BASSE ENERGIE. (Utilization of Linear Accelerators for Experiments on Low-Energy Neutron Physics). A. Michaudon (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay).

The type of research made in low-energy neutron physics, the time-of-flight method for experimentation in this domain, and the utilization of a linear accelerator as a source of pulsed neutrons are briefly reviewed. As an illustration, the Saclay linear accelerator and the studies made with it on neutron transmission, fission, and radiative capture are examined. The characteristics of six linear accelerators used as pulsed neutron sources are compared. (tr-auth)

10692 (LNF-63/47(p.239-47)) POSSIBILITA' DI UN IMPIEGO DEL LINAC DA 450 Mev QUALE INIETTORE PER UN ELETTROSINCROTRONE DA 10 Gev. (Possibility for the Use of a 450-Mev Linac Installation as an Injector for a 10-Bev Electron Synchrotron). U. Bizzarri, and M. Conte (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

The availability of a 400 to 500 Mev linac of high intensity has suggested its use as an injector for a high-energy electron synchrotron. A preliminary study of this possibility is based on the design study by R. Wilson of a 10-Bev electron synchrotron. The principal parameters and an estimation of the cost of such a synchrotron are tabulated. Possible applications of such a machine include positron acceleration, double injection of electrons, production of coherent bremsstrahlung, and production of secondary beams of photoproduced particles. (J.S.R.)

10693 (LNF-63/47(p.255-8)) APPENDIX. PRELIMINARY SURVEY OF POSSIBLE RESEARCHES WITH AN ELECTRON AND POSITRON LINEAR ACCELERATOR. (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

A brief discussion is given of the studies possible with the Frascati linear accelerator which will have a maximum energy around 400 Mev. The possible studies considered are nuclear physics investigations with electrons, positrons, γ rays, and neutrons, electrodynamic investigations with electrons, positrons, and photons, π-meson physics studies with electrons and positrons, π meson photoproduction, and weak interaction physics. (J.S.R.)

10694 (NP-13571(p.14-17)) A "BEAM DUMP" MAGNET DESIGN. K. Murray (Naval Research Lab., Washington, D. C.).

A design for a magnet to dispose of the component of an electron beam that passes through the target with which it has interacted is derived. The electrons are bent sharply (90°) toward the floor and absorbed near floor level, thereby reducing background. (D.C.W.)

10695 (NP-13571(p.18-20)) SOME CONSIDERATIONS IN THE ALIGNMENT OF A LONG ELECTRON BEAM SUBJECT TO MANY SMALL ZERO-GRADIENT SCATTERING FORCES. D. dePackh (Naval Research Lab., Washington, D. C.).

The random-walk buildup of betatron oscillations resulting from misalignments and other similar perturbations along the beam is examined. (D.C.W.)

10696 (SLAC-25(Pt.I)) 1963 SUMMER STUDY REPORT. PART 1. (Stanford Univ., Calif. Stanford Linear Accelerator Center). Contracts AT(04-3)-400 and AT(04-3)-476. 210p.

Separate abstracts were prepared for the thirteen sections of the report. (D.C.W.)

For abstracts of individual sections see: 10697, 10698, 10699, 10700, 10701, 10878, 10879, 10880, 10881, 10882, 10883, 10884, and 11217.

10697 (SLAC-25(Pt.I)(p.1-18)) COMPARISON OF ESTIMATED PION FLUXES AT THE AGS WITH PION FLUXES EXPECTED AT SLAC. D. B. Lichtenberg (Indiana. Univ., Bloomington).

The pion fluxes expected from the linear accelerator were calculated and compared with estimates of the fluxes at the synchrotron. The results, subject to the calculational assumptions, indicate that approximately the same number of high-energy pions are produced at the synchrotron by 2×10^{11} 30-Bev protons as can be expected from 3×10^{14} 20-Bev electrons. (D.C.W.)

10698 (SLAC-25(Pt.I)(p.30-62)) BEAM CURRENT MONITORS FOR A HIGH ENERGY LINAC. D. B. Isabelle (National Bureau of Standards, Washington, D. C.).

The different types of classical monitors used with linear accelerators are examined, and their possible adaptation to the Stanford Linear Accelerator is considered. It is concluded that none of the present monitors will provide accurate beam monitoring over the required range (30×10^{-9} amp to 150×10^{-6} amp). (D.C.W.)

10699 (SLAC-25(Pt.I)(p.63-87)) POSITRON BEAM FROM THE SLAC ACCELERATOR. J. Pine (California Inst. of Tech., Pasadena. Sloan Lab. of Physics).

The angular, energy, and spatial distributions of positrons emerging from the radiator are examined, together with beam transport from the radiator to the beam switchyard. The mechanical and thermal problems associated with the radiator are also considered. The main conclusion is apparent feasiblity of obtaining a positron beam with an intensity $\geq$1% of the electron beam incident on the radiator. (D.C.W.)

10700 (SLAC-25(Pt.I)(p.149-59)) POSSIBILITIES WITH A 2 Bev/c SPECTROMETER FOR ELECTRON-PROTON SCATTERING AT SLAC ENERGIES. C. de Vries (Amsterdam. Institutt voor Kernphysisch Onderzoek).

Consideration of some economic, experimental, and theoretical aspects indicates that a 2 Bev/c spectrometer would be more practical than the suggested 20-Bev device. A possible design for a 2-Bev/c spectrometer is presented, and its projected characteristics are discussed. (D.C.W.)

10701 (SLAC-25(Pt.I)(p.160-6)) ELECTRON-PROTON SCATTERING AT 180°. C. de Vries (Amsterdam. Institutt voor Kernphysisch Onderzoek).

An experimental arrangment for 180° scattering at Stanford linear accelerator beam energies and intensities is described. Numerical values for the energies, field strengths, bending angles, and various beam optical quantities are included. (D.C.W.)

10702 BALANCE SHEET OF EXPERIMENTS ACHIEVED WITH 5-Mev VAN DE GRAAFF OF SACLAY. E. Cotton. Bull. Inform. Sci. Tech. (Paris), No. 77, 3-16 (Nov. 1963). (In French)

Research on deuteron polarization, gyromagnetic ratios in deformed nuclei, the statistical model and Ericson's

fluctuations, experiments on light nuclei, and work carried out with accelerated lithium ions (which seems to demonstrate the existence of nuclear quasimolecular states) is reviewed. (auth)

10703 EXPERIMENTS WITH 22-Mev DEUTERONS POLARIZED WITH THE CYCLOTRON OF SACLAY. J. Thirion. Bull. Inform. Sci. Tech. (Paris), No. 77, 17-30 (Nov. 1963). (In French)

The polarized deuteron source consists of a device producing an atomic beam together with a sextupole magnet selecting the atoms according to their electronic spin orientation and three high-frequency transitions using the adiabatic method giving a choice of pure vector or tensor polarization of either sign. Ionization of the jet of 22-Mev deuterons is used for experiments on elastic scattering (calcium, hydrogen) as well as on stripping reactions (carbon, silicon). (auth)

10704 THE EVOLUTION OF SATURNE. J. Crussard. Bull. Inform. Sci. Tech. (Paris), No. 77, 31-40(Nov. 1963). (In French)

The various improvements made on the 3-Bev Saclay synchrotron since it began operating are described, along with the steps of its evolution. Progress in the characteristics of secondary beams is illustrated by experiments on 1.15-Bev/c K^+ mesons and on 1-Bev/c μ^- mesons. The beam ejection system and the so called "beam kicker," giving very short pulses on a target, are described. (auth)

10705 COMPUTER PROCESSES TANDEM VAN DE GRAAFF DATA. John Leng (Digital Equipment of Canada Ltd., Ottawa). Can. Nucl. Technol., 3: 45-9(1964).

An integrated detector-analyzer-computer system for tandem Van de Graaff experiments is described. (C.E.S.)

10706 ON A METHOD FOR CALCULATING MAGNETIC SYSTEMS IN RING ACCELERATORS WITH CONSTANT FIELD. V. N. Kanunnikov (Lebedev Inst. of Physics, Moscow). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 5, 118-23(1963). (In Russian)

Methods are given for calculating magnet parameters for ring accelerators with constant fields. Solutions were obtained for the scalar magnetic potential for a general three-dimensional boundary value problem and for an approximate two-dimensional field distribution. (tr-auth)

10707 ENERGY DISTRIBUTION OF PROTONS HITTING AN INTERNAL TARGET IN A SYNCHROCYCLOTRON. Y. Le Beyec, M. Lefort, and X. Tarrago (Faculté des Sciences, Orsay, France). J. Phys., 24: Suppl. to No. 10, 157A-61A(Oct. 1963). (In French)

Betraton oscillations are responsible for the large irradiated area on targets placed in the internal beam of a synchrocyclotron. Experiments are described, which make possible the determination for protons hitting the surface of the target, of intensity distribution versus distance from the edge and energy width and equivalent medium energy. The results show that it is not advisable to use without care the simple relation between energy and radius $\sqrt{E^2 - E_0^2}$ = r.B.e.c. (auth)

10708 SHIELDING MODERATE-ENERGY ELECTRON ACCELERATORS. Kenneth M. Murray (Naval Research Lab., Washington, D. C.). Nucleonics, 22: No. 2, 61-7 (Feb. 1964).

Methods, calculations, and references (19) accumulated in shielding research at NRL are presented. Economical solutions to radiation problems of linac installations and other electron accelerators of 100 Mev are attempted. (R.E.U.)

10709 THE ORSAY LINEAR ACCELERATOR. A. Blanc-Lapierre and J. L. Delcroix (Ecole Normale Supérieure, Paris and Faculté des Sciences, Paris). Onde Elec., 43: 597-8(June 1963). (In French)

The performance of the linac and the history of its materials of construction are discussed. (R.E.U.)

10710 PHYSICAL PROBLEMS IN CONSTRUCTION OF THE [ORSAY] 1-Gev ACCELERATOR. H. Leboutet. Onde Elec., 43: 599-622(June 1963). (In French)

The choice of fundamental design parameters for the Orsay linac is discussed. The problems in construction and reaching operational conditions are reviewed. (R.E.U.)

10711 DESCRIPTION OF THE ORSAY ACCELERATOR. I. THE ACCELERATING MECHANISM. R. Jean. Onde Elec., 43: 623-31(June 1963). (In French)

The accelerator was divided into 16 sections, each of a useful length of 6.1 meters, to obtain an energy of 1 Bev. A uniform structure design, similar to that of the Stanford accelerator, was rejected so as to reduce the overall length, and the h-f power required. The accelerating mechanism is made of preadjusted elements assembled under pressure resulting in a constant field structure. In this way an energy level of 62.5 Mev was obtained for each section with an h-f supply of only 18 Mw. The building and control methods are described. The supply system was specially designed to avoid the introduction of a radial component into the accelerating field. (auth)

10712 DESCRIPTION OF THE ORSAY ACCELERATOR. II. STABILITY AND SPECTRUM BANDWIDTH IN LINEAR ACCELERATORS. R. Jean. Onde Elec., 43: 632-6(June 1963). (In French)

The needs of the users have led to research into conditions where a beam is accelerated to a given energy level, in a stable state, and within as narrow as possible a bandwidth. The theoretical examination of these requirements has made it possible to define the permitted tolerances in setting up the accelerating mechanism and with respect to the pilot's reference frequency and the supply voltages to the klystron amplifiers. The tolerances for the accelerator are within the reach of modern manufacturing methods. It was more difficult to meet the specifications for the pilot's modulators and amplifiers with the required beam characteristics. (auth)

10713 DESCRIPTION OF THE ORSAY ACCELERATOR. III. THE MODULATORS. E. Oger and B. Bonvalot. Onde Elec., 43: 637-50(June 1963). (In French)

The accelerator comprises 22 modulators (75 Mw) and the auxiliary modulators (pilot, pre-amplifier, injector). All these modulators work on the same principle; that of a delay line charged to a high voltage and discharged into the appropriate circuit at the correct time by a switch. A thyratron is used for the pilot (1.1 Mw), a 3 electrode discharger for the pre-amplifier (15 Mw) and a multiple discharger for the modulators (75 Mw). After describing the basic principles of the discharger, and its advantages, the design of the modulator is outlined. The injection modulator works without an impulse transformer, with a distributed constant type of line charged to 90 kv and two dischargers; a 3-electrode and a 2-electrode type. The synchronization is effected by a multichannel impulse generator, the signal delay being variable. (auth)

10714 DESCRIPTION OF THE ORSAY ACCELERATOR. IV. THE KLYSTRONS. O. Doehler, P. Paulluel, and G. Henry-Bezy. Onde Elec., 43: 651-61(June 1963). (In French)

The realization of a 1-Bev electron accelerator was made easier by the use of high power klystron amplifiers working under sealed conditions. These four-cavity klystrons produce a peak power of over 20 Mw at a voltage of 240 kv. Their gain is greater than 40 dB's within a 50 Mc/s bandwidth. A high stability klystron oscillator is also described. A long-term service under sealed conditions results from the construction and pumping techniques employed. The accuracy of duplication and the reliability performance under working conditions are analyzed. The stability in performance under the conditions required by the accelerator (power, phase, frequency) is a function of the limits imposed on the variations of the high tension supply. Various design concepts for the production of higher performance klystrons are outlined. (auth)

10715 DESCRIPTION OF THE ORSAY ACCELERATOR. V. FOCUSSING AND DIRECTING THE BEAM. R. Jean. Onde Elec., 43: 662-3(June 1963). (In French)

The electron beam must be focussed by an axial magnetic field, up to an energy level of 50 to 100 Mev, to overcome the space-charge and the radial component of the accelerating electric field. The applied field was calculated by a simple method that is developed. Correction coils and magnetic screens are also provided to counter the effects on random magnetic fields. The complete arrangements are described. (auth)

10716 DESCRIPTION OF THE ORSAY ACCELERATOR. VI. THE VACUUM. R. Jean and R. Liot. Onde Elec., 43: 664-7(June 1963). (In French)

The vacuum system of the Orsay accelerator is described. The 45 pumps are spread out along the length of the accelerator and are divided into five groups, each comprising a low-capacity mechanical pump and an ejector. The high-frequency sections are pumped by 22 groups each comprised of a diffusion pump and a valve pump. (R.E.U.)

10717 DESCRIPTION OF THE ORSAY ACCELERATOR. VII. THE BUILDING AND GENERAL EQUIPMENT. J. Verlon (Ecole Normale Supérieure, Orsay, France). Onde Elec., 43: 668-72(June 1963). (In French)

The particular characteristics of the equipment installed are described and the difference between such an installation and a laboratory apparatus is emphasized. The equipment and building construction required housing of an accelerator 100 meters in length, capable of generating 1 Bev with facilities for extracting energy at intermediate levels. (auth)

10718 DESCRIPTION OF THE ORSAY ACCELERATOR. VIII. PERFORMANCE. L. Burnod (Ecole Normale Supérieure, Orsay, France). Onde Elec., 43: 673-7(June 1963). (In French)

The characteristics and performance of the Orsay linear accelerator are given. The optimum adjustment of such a machine, in spite of the great number of variables, is facilitated by the use of several detectors that also allow measurements to be made on the beam structure. (auth)

10719 DEVELOPMENT OF METHODS OF MEASUREMENT AND REGULATION. I. GENERAL ASPECTS OF THE PHASE RELATIONSHIP BETWEEN THE ACCELERATING H.F. WAVE AND THE ELECTRON BEAM AT THE INPUT OF A LINEAR ACCELERATOR STAGE. P. Brunet (Ecole Normale Supérieure, Orsay, France). Onde Elec., 43: 678-87(June 1963). (In French)

On a multisection electron linear accelerator (high energy), the frequency and the phase of the accelerating wave at the input of each section are two fundamental and critical interdependent parameters. The optimum phase is defined and calculated for all working conditions. A numerical example is worked out for a section equivalent to one of the Orsay models. It is this optimum phase that determines the proper adjustment of the machine and can be obtained either manually or automatically. (auth)

10720 DEVELOPMENT OF METHODS OF MEASUREMENT AND REGULATION. II. INFLUENCE OF THE CURRENT IN A LINEAR ACCELERATOR. L. Burnod (Ecole Normale Supérieure, Orsay, France). Onde Elec., 43: 688-93(June 1963). (In French)

One reason for a waste of energy in a linear accelerator's electron beam is the existence of a transition state due to the progressive attenuation of the high frequency field. After describing a general design method independent of the accelerating structure, and the waveform of the current and h-f pulses, this method is applied to the Orsay accelerator. The theoretical results, experimentally confirmed, allow the derivation of two methods for increasing the current within a narrow energy band. These methods were successfully applied to the Orsay accelerator. (auth)

10721 PROBLEMS OF RADIATION CONTROL IN THE ORSAY LINEAR ACCELERATOR. G. Dardenne (Ecole Normale Supérieure, Orsay, France). Onde Elec., 43: 694-9(June 1963). (In French)

The necessary protection requirements are defined, the protection devices described, and measurements on the efficiency of the devices are given for radiation under working conditions with a beam, radiation with high frequency only, and radiation after accelerator shutdown. (auth)

10722 FUTURE POSSIBILITIES OF HIGH-ENERGY LINEAR ACCELERATORS. H. Leboutet. Onde Elec., 43: 700-2(June 1963). (In French)

The analysis of Orsay accelerator problems prior to construction is shown to be useful in the future construction of higher energy machines. The problems connected with critical adjustments and with frequency reference are discussed. (R.E.U.)

10723 TRANSVERSE SPACE-CHARGE EFFECTS IN A BEAM OF ELECTRIFIED PARTICLES: PROTON SYNCHROTRON SATURNE. J. Faure, M. Gouttefangeas, R. Lévy-Mandel, R. Vienet, B. Lago, and J. Loeb. Onde Elec., 43: 752-62(July-Aug. 1963). (In French)

An effect that tends to modify the transverse dimensions of a beam owing to the space-charge between the particles forming the beam is discussed. The problem is first studied statistically, then starting from Boltzmann's theorem, a method of calculation is developed. A linear method leading to approximate results is then suggested to determine the best starting conditions and the definition of a simple stationary beam. (auth)

10724 GAS STRIPPER FOR A HEAVY-ION LINEAR ACCELERATOR. Robert Beringer (Yale Univ., New Haven). Rev. Sci. Instr., 35: 245-6(Feb. 1964).

A differentially pumped gas stripper for use in a heavy-ion linear accelerator is described. The stripping gases, air, oxygen, and argon, give the same stripping efficiency for ions in the range boron to neon for those charge states used in the accelerator. (C.E.S.)

10725 ELECTRON GUNS, 2 AND 4 INCH (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). (CAPE-999)

Forty-two drawings are included. The electron guns are used as sources in the Single Cavity High Current Electron Accelerator, which is a full scale prototype of the triple cavity, high current accelerator. The single cavity accelerator will be used in studies of high current electron streams. The machine employs a 2.4 m long, 50 Mc cavity in which fields up to 5×10^6 v/m have been achieved. Excitation power is generated by two tuned-plate, tuned-grid amplifiers. Four 250-liter/sec Vac Ion pumps hold the cavity pressure in the low end of the 10^{-7} mm Hg range. One 400-liter/sec Vac Ion pump is used to exhaust the electron gun chamber to comparable pressure. The electron sources operate space charge limited up to at least 250 kv with a perveance of about 10^{-6}. Square wave pulses, 0.2 μsec long, are generated by a pulser. (F.S.)

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Refer also to abstract 11087.

10726 (NP-13522) A SURVEY OF THE MEASUREMENTS OF SOLAR ULTRAVIOLET, X, AND GAMMA RADIATION. VOLUME I. Technical Note 62-2. E. W. Hones, Jr. (Institute for Defense Analyses, Washington, D. C.). Feb. 1962. Contract SD-50. 266p.

The methods and results of measurements of the solar short-wave radiation are discussed; and all the rocket, balloon, and satellite measurements reported in scientific literature are tabulated. Copies of articles that give a complete account of measurements to date are included. (D.C.W.)

10727 (NP-13550) RESEARCHES IN THE FIELD OF SOLAR RADIO NOISE AND SUNSPOTS. Annual Report for 1962. Svein Rosseland (Oslo. Universitetet. Institutt for Teoretisk Astrofysikk). Jan. 31, 1963. Contract AF61 (052)-186. 26p.

Observations of noise storm bursts revealed the occurrence of very short-lived (flash) bursts in addition to the common burst activity. Other types of bursts were also investigated, as was possible interference in solar noise due to meteor trails. A possible connection was established between the occurrence of solar radio noise storms and the Evershed effect in sunspot regions. A radio spectrograph and apparatus for polarization measurements on bursts are under construction. Further observations on the Evershed effect and on intermittent and revival sunspot groups were made. The relations between magnetic fields, life period, and areas of sunspots were investigated, together with the life history of short-lived spots. Theory on thermal conduction in solar plasma was also advanced. (D.C.W.)

10728 ANNUAL REVIEW OF ASTRONOMY AND ASTROPHYSICS. VOLUME I. Leo Goldberg, ed. Ann. Rev. Astron. Astrophys., 1: 1-418(1963).

Articles of current interest in the fields of astronomy and astrophysics are presented. The topics include radio telescopes, solar granulation, solar magnetic field, solar uv and x rays, mass loss from stars, novas and novalike stars, the content of galaxies, the dynamics of galaxies, magnetic fields and spiral structure, celestial mechanics, terrestrial planets, interstellar grains, solar bursts, and the physical basis of the pulsation theory of variable stars. Extensive bibliographies are included after each section. Separate abstracts are prepared for 9 of the 14 papers presented. One paper was previously abstracted in NSA. (C.E.S.)

For abstracts of individual papers see: 10729, 10730, 10731, 10732, 10733, 10734, 10735, 10736, and 10737.

10729 THE SOLAR GRANULATION. Robert B. Leighton (California Inst. of Tech., Pasadena). Ann. Rev. Astron. Astrophys., 1: 19-40(1963).

Subsurface convective motions in the sun that produce, at the surface, the cellular pattern called solar granulation are discussed. The view is adopted that the granulation is but a broad complex of phenomena of the quiet sun that begin below the visible surface and extend upward at least into the chromosphere and perhaps into the corona. The atmospheric waves induced by the convective motions and the relation of these waves to the chromospheric structure seen on spectroheliograms are considered. Supergranulation, a flow pattern resembling the granulation but on a twenty-fold larger scale, is described, and its relation to the well-known chromospheric network is discussed. (C.E.S.)

10730 THE SUN'S MAGNETIC FIELD. H. W. Babcock (California Inst. of Tech., Pasadena and Carnegie Institution of Washington, D. C.). Ann. Rev. Astron. Astrophys., 1: 41-58(1963).

The techniques and instruments for measuring the solar magnetic field are outlined. The poloidal field and low-latitude fields are discussed. The magnetic fields associated with sunspots, flares, stable filaments, and granules are considered. The solar magnetic cycle and related phenomena are also discussed. (C.E.S.)

10731 ULTRAVIOLET AND X RAYS FROM THE SUN. Herbert Friedman (Naval Research Lab., Washington, D. C.). Ann. Rev. Astron. Astrophys., 1: 59-96(1963).

Solar ultraviolet spectroscopy is discussed, and the present state of knowledge regarding the existence of all ions of atomic numbers 1 to 16 and of Fe in the solar chromosphere and corona based on extreme ultraviolet emission lines is summarized. The best available flux data on solar ultraviolet emission lines from about 1900 Å down to 100 Å are also given. The coronal x-ray spectra and the distribution of coronal x-ray sources are considered. The form of the corona above active regions and solar flare x-ray emission are also discussed. (C.E.S.)

10732 MASS LOSS FROM STARS. Ray Weymann (Univ. of Arizona, Tucson). Ann. Rev. Astron. Astrophys., 1: 97-144(1963).

Statistical, theoretical, dynamical, and spectroscopic evidence for mass ejection in early- and late-type stars is reviewed. Theories of catastrophic mass loss and interpretations of supernova and nova phenomena are discussed. Stellar wind theories of mass ejection in late-type stars and theories of mass loss in early-type stars are outlined. (C.E.S.)

10733 NOVAE AND NOVALIKE STARS. Cecilia Payne Gaposchkin (Harvard Univ., Cambridge, Mass.). Ann. Rev. Astron. Astrophys., 1: 145-8(1963).

The binary nature of U Geminorium stars, observations of novas and supernovas, and the shock wave theory of novas are discussed. (C.E.S.)

10734 THE CONTENT OF GALAXIES: STARS AND GAS. Morton S. Roberts (Harvard Univ., Cambridge, Mass.). Ann. Rev. Astron. Astrophys., 1: 149-78(1963).

The stellar content of a galaxy is described by a bivariate frequency function f(M,S), where M denotes absolute magnitude and S some definite measure of spectral type or

color. The derivation and description of f(M,S), the spectrum-luminosity function, are discussed. Optical and radio studies of the gaseous content of galaxies are also considered. The relation between f(M,S) and the gaseous content of galaxies and a time scale of galactic evolution based on this relation are discussed. (C.E.S.)

10735 THE DYNAMICS OF GALAXIES. Ivan R. King (Univ. of Illinois, Urbana). Ann. Rev. Astron. Astrophys., 1: 179-94(1963).

Brightness distributions, velocity dispersions, and rotation of elliptical galaxies are discussed. Gravitational forces between multiple galaxies and groups are considered. Optical rotation curves and radio observations of spiral and irregular galaxies are described. Theoretical models for the dynamics of galaxies are also discussed. (C.E.S.)

10736 MAGNETIC FIELDS AND SPIRAL STRUCTURE. Donat G. Wentzel (Univ. of Michigan, Ann Arbor). Ann. Rev. Astron. Astrophys., 1: 195-218(1963).

The importance of magnetic forces in explaining galactic spiral structure is considered. Relevant hydromagnetic concepts are discussed. The interstellar magnetic field, deviations from galactic circular motions, and the circulation and formation of spiral arms are also discussed. (C.E.S.)

10737 PHYSICAL BASIS OF THE PULSATION THEORY OF VARIABLE STARS. S. A. Zhevakin (Gorkii State Univ., USSR). Ann. Rev. Astron. Astrophys., 1: 367-400(1963).

A brief historical survey of the development of the pulsation theory of stellar variability is given. The problem of stellar auto-oscillations, the physical basis of the theory of stellar variability, and the universal interpretation of the different types of pulsating variable stars are discussed. (C.E.S.)

10738 SOME RELATIONSHIPS BETWEEN 10.7-CENTIMETER SOLAR NOISE BURSTS, FLARES, AND SHORT-WAVE FADEOUTS. Gladys A. Harvey (National Research Council, Ottawa). Astrophys. J., 139: 16-44 (Jan. 1, 1964).

Relations between 1953 solar noise bursts (10.7-cm), 4527 flares, and 928 short-wave fadeouts that occurred during concurrent observing periods from July, 1957, to December, 1960, are investigated. The bursts are those that were unambiguously identified on solar patrol records; the flares are those for which at least one observer estimated the importance to be equal or greater than 1. Attention is focused on the importance and longitude of the flares, the importance and type of the fadeouts, and the intensity, energy, and type of the bursts. A simplified-type classification is used in which a burst is identified as impulsive, long-enduring, or a combination of impulsive and long-enduring parts. Events in which all three of the features—flare, fadeout, and burst—are manifested are not exclusively of large magnitude: the flares and fadeouts range in importance from 1– to 3+; the bursts range in maximum intensity and energy from a few units to several thousands of units. However, an increasing percentage of association is observed as the magnitude of the event increases. The type of burst is closely associated with the type of fadeout—impulsive burst with S-SWF and long-enduring burst with G-SWF and Slow S-SWF. Observed differences in longitude distribution suggest that bursts unaccompanied by SWF originate in a lower level of the solar atmosphere than bursts accompanied by SWF, and long-enduring bursts accompanied by SWF originate in a lower level of the solar atmosphere than impulsive bursts accompanied by SWF. No associations were found for 70 per cent of the flares, 10 per cent of the fadeouts, and 34 per cent of the bursts. In general, these events are of small magnitude. (auth)

10739 DYNAMICAL PROPERTIES OF STELLAR CORONAS AND STELLAR WINDS. I. INTEGRATION OF THE MOMENTUM EQUATION. E. N. Parker (Univ. of Chicago). Astrophys. J., 139: 72-92(Jan. 1, 1964).

The hydrodynamic momentum and mass flow equations are integrated for a stellar corona with spherical symmetry about the center of the star. The coronal temperature is taken to be a known function T(r) of radial distance. The general properties of the equations are discussed, and it is shown that if the corona is tightly bound by the solar gravitational field, so that the thermal velocity is small compared to the gravitational escape velocity, and if the coronal temperature declines outward more slowly than $1/r$, then the corona is quasi-static at its base and expands to supersonic velocity in space. No alternative is available. The stellar mass loss resulting from the expansion is determined by the coronal temperature between the base of the corona and the point at which the flow becomes supersonic. The amount by which the velocity of the resulting stellar wind exceeds the thermal velocity in the corona depends principally upon the temperature beyond the point where the flow becomes supersonic. (auth)

10740 DYNAMICAL PROPERTIES OF STELLAR CORONAS AND STELLAR WINDS. II. INTEGRATION OF THE HEAT-FLOW EQUATION. E. N. Parker (Univ. of Chicago). Astrophys. J., 139: 93-122(Jan. 1, 1964).

The temperature T(r) in a stellar corona is computed under the circumstances that energy is supplied outward from the base of the corona only by thermal conduction. The heat-flow equation is solved analytically under a variety of circumstances. It is shown that the energy flow to infinity is non-vanishing for finite coronal density and thermal conductivity. The temperature declines less rapidly than $1/r$, and a supersonic stellar wind is the only available solution of the equations compatible with negligible pressure at $r = \infty$. A variety of asymptotic cases are worked out to illustrate some of the temperature profiles T(r) to be expected under various circumstances. For instance, in a corona of very low density the energy consumed by expansion of the corona can be neglected and $T(r) \propto r^{-\frac{7}{6}}$, as in Chapman's original static coronal model. The result is a supersonic stellar wind with a velocity $v(\infty)$ of the same order as the gravitational escape velocity $2^{\frac{1}{2}}w$. In a corona with medium density and sufficiently low temperature that $v(\infty)$ is small compared to w, a near region, in which $T(r) \propto r^{-\frac{7}{6}}$ extends for some distance outward from the star before the far region, $T(r) \propto r^{-\frac{3}{2}}$, takes over. The result is a supersonic stellar wind velocity $v(\infty)$ of the same order as the characteristic thermal velocity c_0 at the base of the corona. In a corona that is exceedingly dense, an intermediate region in which $T(r) \propto r^{-1}$ appears between the near and the far regions, which has the result of extending to large distance the point at which the coronal expansion becomes supersonic. In a corona that is exceedingly hot ($c_0 \approx w$) the expansion becomes so violent that thermal conduction becomes negligible and the behavior of the corona is approximately adiabatic. It is shown that any effect that tends to reduce the thermal conductivity of the coronal gases at large distance from the star has the effect of enhancing the velocity of the stellar wind. Comparison with Chamberlain's earlier discussion of the solution of the momentum and heat-flow equations in his solar-breeze model shows that he made two self-consistent errors in

his assumption that the energy flux in the solar wind is identically zero and that the gas motion is adiabatic at large radial distances from the sun. It is shown that neither assumption is correct in a corona of finite density. It is shown, however, that the analytical form $T(r) \propto 1/r$ suggested by Chamberlain is obtained in the limit as the density of the corona is made large without limit, in which case all motion in the corona approaches zero. Application of the solutions of the heat-flow equation to the sun—assuming that the solar corona is heated solely by thermal conduction—show that at least under present conditions the solar corona and wind lie in the middle ground between high and low density and temperature. Assuming that they have coronas heated solely by conduction it is suggested that some of the giant stars with the low gravitational escape velocities, may fall into the high-density case, and certain dwarfs into the low-density case. Some of the very active stars may fall into the high-temperature quasi-adiabatic case. (auth)

10741 STELLAR X-RAY EMISSION. Philip C. Fisher and Arthur J. Meyerott (Lockheed Missiles and Space Co., Palo Alto, Calif.). Astrophys. J., 139: 123-42(Jan. 1, 1964).

Measurements of night-sky regions emitting photons having energies between 1 and 20 kev are described. Isophote plots are given for a portion of the sky near 5 hours of right ascension for photons in three non-contiguous energy intervals. The plots were derived from data obtained from several different gas-proportional counters carried aboard each of two sounding rockets. Locations of at least six regions, emitting, photons in at least two of the three different energy intervals, are given. Absolute luminosities for 2–8-Å photons are presented for the nearest of the stellar objects tentatively associated with these regions. (auth)

10742 THE MANGANESE STAR 53 TAURI. Lawrence H. Aller (Univ. of California, Los Angeles) and William P. Bidelman. Astrophys. J., 139: 171-89(Jan. 1, 1964).

The chemical composition of the atmosphere of the manganese star 53 Tauri was studied with the aid of data secured with the coudé spectrograph of a 120-inch reflector. Transition probabilities required for the problem were obtained from laboratory sources whenever possible, but some were obtained by the calibration of stellar data. The temperature of the star, deduced from ionization equilibria, is near 11,000°K—a value in good agreement with that found from spectral energy scans by Sargent and Jugaku. The electron pressure in the atmosphere, deduced from the total intensities of the hydrogen lines, appears to lie in the neighborhood of 500 dynes cm^{-2}. Several striking abundance anomalies are found; they cannot be explained by deviations from local thermodynamic equilibrium. Manganese seems to be the most abundant metal in the star, but gallium appears to show the greatest enhancement of abundance over the normal value. Strontium, yttrium, and zirconium are also enhanced in abundance, while chromium and calcium seem to be depleted. (auth)

10743 ABUNDANCE OF METASTABLE HYDROGEN MOLECULES IN THE INTERSTELLAR MEDIUM. J. M. Malville (Univ. of Michigan, Ann Arbor). Astrophys. J., 139: 198-207(Jan. 1, 1964).

Equilibrium abundances of the ground and metastable, $c^3\Pi$, states of molecular hydrogen are calculated for a variety of conditions in the interstellar medium. The effects of trapping H_2 on interstellar grains are discussed. It appears unlikely that conditions exist in the interstellar medium where the abundance of the metastable molecular hydrogen is sufficient to account for the observed equivalent width of λ 4430. (auth)

10744 THE HYDROGEN RADIATION SPECTRUM IN GASEOUS NEBULAE. Eugene R. Capriotti (Univ. of Wisconsin). Astrophys. J., 139: 225-39(Jan. 1, 1964).

The emission in the Balmer and Paschen lines from idealized nebulae taking into account self-absorption of Balmer photons. The nebulae considered are spherical shells with various ratios of radii. The nebulae are assumed to be at a constant electron temperature and electron density throughout and to be homogeneous in regard to the population in the 2p level. Only radiative transitions are considered and upward transitions are assumed to occur only from the 1s level and the 2p level. Photons are assumed to be emitted with Doppler profiles and absorbing atoms are assumed to have a Maxwellian velocity distribution. The intensities in the Balmer and Paschen lines calculated by Burgess for Case B of Baker and Menzel are used as source emissivities and the energy escaping the nebula in each Balmer and Paschen line is calculated by counting the number of conversions of Balmer photons as a result of their self-absorption for a number of total optical depths in Hα. The results of these calculations are compared to previous theoretical results and to observational results. The conclusion reached is that even for the case of no self-absorption, when compared to observations of various planetary nebulae, the theoretical models in most cases show decrements that are too flat. (auth)

10745 LINEAR POLARIZATION OF THE CENTIMETER RADIATION OF DISCRETE SOURCES. C. H. Mayer, T. P. McCullough, and R. M. Sloanaker (Naval Research Lab., Washington, D. C.). Astrophys. J., 139: 248-68(Jan. 1, 1964).

A series of observations made to determine the linear polarization of the radiation of the intense discrete sources at several wavelengths between 3.15 and 11.5 cm is presented. The radiation of the Crab Nebula and of the radio galaxies Cygnus A and Centaurus A was found to be partially linearly polarized, and the wavelength dependence of the polarization was investigated. The radiation of the galactic source Cassiopeia A and the radio galaxy Virgo A, on the other hand, shows little evidence of linear polarization. Negative results were also found for the Orion and Omega emission nebulae and for Sagittarius A. The observations of the Crab Nebula at a number of wavelengths show a decrease in the degree of polarization from 7 to 2.6% between 3.15 and 11.5 cm, and indicate a small Faraday rotation of the plane of polarization with an extrapolated position angle at zero wavelength of 146°. The observed degree of polarization of Cygnus A was found to decrease rapidly with increasing wavelength, from 7.5% at 3.15 cm to 0.5% at 9.45 cm. The degree of polarization of Centaurus A is 13.5% at 3.15 cm and 7.2% at 9.45 cm, and the observed orientations of the plane of polarization are consistent with longer wavelength results of other observers in indicating a small Faraday rotation with an extrapolated position angle at zero wavelength of 147°. (auth)

10746 A MASS-POTENTIAL-ENERGY RELATIONSHIP IN ELLIPTICAL GALAXIES AND SOME INFERENCES CONCERNING THE FORMATION AND EVOLUTION OF GALAXIES. Robert A. Fish (Univ. of California, Berkeley). Astrophys. J., 139: 284-305(Jan. 1, 1964).

Photometric results are presented for twenty-nine elliptical galaxies, with the objective of finding a general relation—if one exists—between the mass and the potential energies of elliptical galaxies. The potential energies of

these galaxies are found to be proportional to the three-halves power of the masses, for galaxies from 3×10^9 to 3×10^{12} solar masses. The form of the mass-potential-energy relation characterizes the radiation processes that took place during the collapse of the protogalactic gas cloud into a galaxy. Evidence is presented that the collapse was opacity-limited, and that radiation was controlled by this factor rather than by the time required for free collapse. Synchrotron radiation evidently did not play a dominant role during the contraction of the ellipitcal protogalaxies. The photometric results, in conjunction with velocity dispersions previously measured, provide a mean mass-to-light ratio for elliptical galaxies of 31.3. An apparent correlation of mass-to-light ratio with mass is attributed to a biased sample. Elliptical galaxies in the sample that are associated with spirals of type Sb or Sc have low mass-to-light ratios (approximately 10). The single elliptical galaxy in the sample with an Sa-spiral companion has a normal mass-to-light ratio of about 31.5. If elliptical galaxies become less luminous with time, Sb- and Sc-spirals are apparently younger than the typical elliptical galaxy, while Sa-spirals may be of comparable age. (auth)

10747 A NEW METHOD OF AUTOMATIC COMPUTATION OF STELLAR EVOLUTION. L. G. Henyey, J. E. Forbes, and N. L. Gould (Univ. of California, Berkeley). Astrophys. J., 139: 306-17(Jan. 1, 1964).

A method is described for obtaining time sequences of stellar models describing evolutionary changes. This method is a modified version of an earlier one described by Henyey, Wilets, Böhm, LeLevier, and Levée. The modifications involve the evaluation of all quantities at the same discrete points. The technique provides for coupling the interior integrations to those for model atmospheres based on mixing-length theory. The scope of the formalism is such as to provide for a wide range of calculations for spherically symmetric configurations in hydrostatic equilibrium. (auth)

10748 ELECTRON CAPTURE IN STELLAR INTERIORS. John N. Bahcall (California Inst. of Tech., Pasadena). Astrophys. J., 139: 318-38(Jan. 1, 1964).

The reasons why nuclear electron-capture rates in stars depend on temperature and density are discussed, and some astrophysical applications of continuum electron-capture rates are reviewed. The modern theory of nuclear β decay is then used to calculate stellar-continuum electron-capture rates for transitions of an arbitrary degree of forbiddenness. The equations that are most useful for astrophysical applications are discussed in detail; particular emphasis is placed upon methods for predicting stellar rates that utilize, whenever possible, terrestrial measurements. Three examples are discussed that illustrate the use of the formulas given; the examples are: the electron-capture lifetime of a proton, the stellar β decay of K^{40}, and the effect of forbidden transitions on the abundances of elements in the iron peak. (auth)

10749 IONIZATION EQUILIBRIUM AT HIGH DENSITIES. Carl A. Rouse (Univ. of California, Livermore). Astrophys. J., 139: 339-45(Jan. 1, 1964). (UCRL-7286-T(Rev.); UCRL-7286-T(Pt.I))

A formulation of pressure ionization of a monatomic material is presented in which the Saha equation is modified by a probability that an ion can exist in a mean atomic volume of radius r_0. This modification is justified by postulating a density-dependent normalization of the isolated atom wave functions. In equation of state calculations at densities of degenerate or partially degenerate stars, the present formulation yields a density of free or mobile electrons to which Fermi-Dirac statistics can be applied to calculate electron pressures and energies. At all densities of stellar interest, that is, from the center of the star to the atmosphere, the modified Saha equation will obtain a continuous and consistent first-order equation of state. Second- and higher-order corrections can be calculated by using the output of the present formulation as the assumed charged densities in cluster expansion-type theories. Results are given for hydrogen and iron with a probability than an ion can exist given by $\Phi(r_0) = \exp - (\gamma a_0/r_0)^3$. The results for hydrogen are shown to be compatible with results from more restrictive models. A method of including temperature-density effects in rigorous calculations of atomic structure is suggested. (auth)

10750 THE SOLAR HELIUM ABUNDANCE. John E. Gaustad (Princeton Univ., N. J.). Astrophys. J., 139: 406-8(Jan. 1, 1964).

Possible sources of the discrepancy between determinations of the solar helium abundance by means of theoretical models and solar cosmic particle measurements are discussed. (C.E.S.)

10751 THE TYPE IV SOLAR RADIO BURST AT METRE WAVELENGTHS. A. A. Weiss (Commonwealth Scientific and Industrial Research Organization, Chippendale, New South Wales). Australian J. Phys., 16: 526-44(Dec. 1963).

Properties of 24 sources of type IV emission at meter wavelengths (including the long-lived continuum storms) were observed by interferometry in the frequency range 40–70 Mc and by dynamic spectroscopy in the frequency range 15–210 Mc. The characteristics investigated are the positions, movements, and angular sizes of the sources, and the spectrum and polarization of the emission. Two varieties of the meter-wave type IV burst with distinctive characteristics, notably in height and movement of the source and in polarization of the emission, were recognized. These two varieties were designated moving and stationary type IV bursts; they are probably separate phenomena related only through a common initiating disturbance. The stationary type IV emission appears to emanate from near the plasma level, but there is no appreciable dispersion of position with frequency over a narrow range of frequencies. No physical distinction is found between the shorter stationary events and the beginnings of the long-lived continuum storms, but notable changes in source properties develop towards the ends of continuum storms. (auth)

10752 SCANNING THE SUN FOR SOLAR FLARES. N. Gutlove and S. Morrison (Republic Aviation Corp., Farmingdale, N. Y.). Electronics 37: No. 7, 31-5(Feb. 14, 1964).

The design and performance of a solar flare alarm system that uses video techniques are discussed. (C.E.S.)

10753 RARE-EARTH, YTTRIUM AND SCANDIUM ABUNDANCES IN METEORITIC AND TERRESTRIAL MATTER. [PART] II. R. A. Schmitt, R. H. Smith, and D. A. Olehy (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Geochim. Cosmochim. Acta, 28: 67-86(Jan. 1964).

Abundances and selected isotopic ratios of the 14 rare-earth elements (REE), yttrium, and scandium were determined by neutron-activation analysis in 13 meteorites and 2 terrestrial specimens: 3 carbonaceous, 2 hypersthenic, and 1 bronzitic (troilite phase) chondrite; 2 calcium-rich and 2 nakhlitic achondrites; 1 mesosiderite;

2 pallasites; an Australian eclogite; and a Columbia Plateau basalt. Absolute abundances of the REE and Sc in 2 Type I carbonaceous chondrites are about 33% less compared with the Type II. Atomic ratios of $Y/10^6$ Si in carbonaceous chondrites remain approximately constant at 4.7 (Type I), 4.1 (Type II), and 4.8 (Type III), and ratios of the REE (La is representative) yielded $La/10^6$ Si at 0.36 (Type I), 0.53 (Type II), and 0.51 (Type III). The REE, Y, and Sc contents in the troilite-phase of a chondrite is ~0.3 of the content in the entire chondritic matrix. REE and Y abundances in Ca-rich achondrites and nakhlites are ~10 and ~5 times larger, respectively, than found in ordinary chondrites. No fractionation of the REE and Y distribution was observed in Ca-rich achondrites compared to chondritic REE and Y; fractionation in nakhlites is similar to terrestrial basalts. Fractionation of the REE and Y (Eu is enriched) in the mesosiderite Veramin and in two pallasites (Eu depleted in one pallasite) was found. The observed fractionation of the REE and Y in Australian eclogite is opposite to fractionation in African eclogite, and fractionation in Columbia Plateau basalt was similar to Kilauea basalt. (auth)

10754 THE MOTION OF MULTIPLY CHARGED CORONAL IONS IN MAGNETICALLY ACTIVE SOLAR PLASMA. E. I. Mogilevskii (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 2: 862-70(1962).

The nature of the observed difference between the values of the electron temperature T_e, determined from ionization theory, and T_z, the temperature of multiply charged z-ions, determined from the Doppler contours of coronal emission lines, is considered. The problem of current explanations of the observed inequality $T_z > T_e^-$ is considered. Data on the characteristic motion of z-ions in plasma, observed in laboratory experiments, are used to explain large values of T_z, the specific dependence of T_z on z, and directed macroscopic motions of z-ions in active regions. There is a discussion of the characteristic motion of multiply charged z-ions in coronal plasma in the presence of weak transient electric fields ($E \gtrsim 10^{-4}$ v/cm) in coronal inhomogeneities. (auth)

10755 ISOTOPIC COMPOSITION OF SILVER IN IRON METEORITES. A. K. Chakraburtty (Univ. of Chicago), C. M. Stevens, H. C. Rushing, and E. Anders. J. Geophys. Res., 69: 505-20(Feb. 1, 1964). (EFINS-63-57)

With a view to developing a new dating method based on extinct 6.8 m.y. Pd^{107}, silver was isolated from 18 samples of the iron meteorites Bristol, Canyon Diablo, Grant, Odessa, Piñon, Sandia Mountains, and Toluca. The silver concentration (11 to 197 ppb) was determined on an aliquot by isotope dilution and also by neutron activation analysis of separate samples. The isotopic composition was measured by surface ionization on a mass spectrometer. No enrichment of Ag^{107} was detected in any of the samples: the δAg^{107} values for Canyon Diablo and Toluca were 1.2 ± 2.3 and 3.5 ± 3.7 per mil, compared with Murthy's values of 40 ± 4 and 22 ± 4 per mil. The grand average of all analyses was 0 ± 1.5 per mil. That this discrepancy was not due to contamination is shown by the low blanks (< 5 per cent), by the agreement of the neutron activation and isotope dilution results, and by other evidence. Sampling error is also not a likely explanation, since its probability is $< 1.6 \times 10^{-9}$ under the most favorable assumptions. Possibly the apparent anomalies found by Murthy are in some way related to the anomalous value he obtained for terrestrial silver ($Ag^{107}/Ag^{109} = 1.064 \pm 0.002$, compared with 1.082 ± 0.002, the average ratio found by four other investigators). (auth)

10756 RADIOACTIVITY OF THE BOGOU SIDERITE. M. W. Rowe, E. C. Anderson, and M. A. Van Dilla (Los Alamos Scientific Lab., N. Mex.). J. Geophys. Res., 69: 521-4(Feb. 1, 1964). (LADC-5931)

The Bogou iron meteorite fell near Bogou, Upper Volta, on August 14, 1962. The main mass of the recovered fall was received on October 28 (75 days after fall), and the γ-ray spectrum was determined by a nondestructive technique using a large (7½- by 4-in.) NaI (Tl) crystal spectrometer. Measured specific activities were 439 ± 22 dpm/kg Mn^{54}, ≤14 ± 6 dpm/kg Sc^{46}, <145 dpm/kg Cr^{51}, <32 dpm/kg Co^{56}, 165 ± 60 dpm/kg Co^{58+58}, 66 ± 24 dpm/kg Co^{57}, and ≤7 ± 4 dpm/kg Co^{60}. These results are compared with the measurements on Aroos and with measurements on a mass of iron that was subjected to a 3-Bev proton bombardment. The Mn^{54} concentrations observed in Bogou, Aroos, and the irradiated iron are in close agreement. Agreement is also noted on all the cobalt isotopes, except Co^{60}, where large variations are expected from meteorite to meteorite. The Sc^{46}, Cr^{51}, and Co^{60} concentrations appear to be lower in Bogou than in Aroos. (auth)

10757 POTASSIUM AND ALUMINUM 26 CONTENTS OF THREE BRONZITE CHONDRITES. E. C. Anderson (Los Alamos Scientific Lab., N. Mex.), M. W. Rowe, and H. C. Urey. J. Geophys. Res., 69: 564-5(Feb. 1, 1964). (LADC-5856)

The Al^{26} and K^{40} contents of three bronzite chondrites were measured in an attempt to determine their cosmic-ray exposure ages and orbital history. (C.E.S.)

10758 EXCITATION OF LUNAR LUMINESCENCE BY SOLAR FLARES. Zdeněk Kopal and Thomas W. Rackham (Univ. of Manchester, Eng.). Nature, 201: 239-41(Jan. 8, 1964).

The consequences of a hypothesis that the temporary enhancement of the Kepler area in the red, observed on Nov. 1-2, was caused by the luminescence of lunar ground covered by meteoritic debris, similar in composition to the samples induced to luminesce under proton bombardment simulating the solar wind, are developed. If the tentative explanation of lunar observations proves to be correct, the enhancement in brightness of the Kepler region on the night of Nov. 1-2 represents the first case on record when the luminescence of lunar ground can be related with specific solar events and would also constitute a proof of the fact that the crater Kepler was produced by impact of a stony meteorite. (P.C.H.)

10759 ROTATING UNIVERSES. J. V. Narlikar (Fitzwilliam House, Cambridge, Eng.). p.222-7 of "Evidence for Gravitational Theories." New York, Academic Press, 1962.

The role of general relativity in cosmology is discussed. A specific form of line element for the smoothed out universe with certain unknown time-dependent functions is assumed, and the field equations used to determine these functions are given. The eigenvalues of the Riemann tensor would then lead to determination of density and pressures. Any assumed anisotropy of space would result in inequality of pressures along different directions. Anisotropy of expansion works in the opposite sense to rotation. (R.E.U.)

Atomic Physics

10760 (AD-403127) GENERAL DISPERSION RELATIONS FOR A PARTIALLY-IONIZED GAS. Report No. 129.

C. E. Prince, Jr., and F. X. Bostick, Jr. (Texas. Univ., Austin. Electrical Engineering Research Lab.). Feb. 28, 1963. Contract Nonr375(14). 45p.

Beginning with Boltzmann's equation and the equation of momentum transfer for a partially-ionized gas, seven basic equations are derived for small-amplitude perturbations. These are used to obtain a determinant, the eigenvalues of which identify five modes of propagation in the most general case. A steady magnetic field and an arbitrary direction of propagation with respect to this field is supposed, and the complications introduced by this general approach are examined by a brief study of simpler cases. It is shown that only by means of a high-speed electronic computer may attenuation factors, and phase group velocities be accurately determined. (auth)

10761 (AERE-R-4426) ATOMIC EMISSION SPECTRA OF PLUTONIUM IN THE REGION 3200-7000Å. E. W. T. Richards and A. Ridgeley (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1963. 152p.

About 8000 spectral lines in the region 3200 to 7000Å were measured and reported, together with associated isotope shifts. Zeeman effect is reported on about 500 of these lines. Zeeman measurements confirm the values of the ground state term of Pu I reported by Blaise, et al. In addition four new levels associated with the configuration $7s^26d5f^6$ were found. (auth)

10762 (AFOSR-4759) FIELD EMISSION IN A MAGNETIC FIELD. F. J. Blatt (Michigan State Univ., East Lansing). [1962]. Contract AF49(638)-70. 15p. (AD-409317)

The variation of the high-field emission current in a longitudinal magnetic field is investigated theoretically in the zero temperature limit within the single-particle, free-electron approximation. Expressions for the emission current are obtained for cases of constant Fermi energy and constant electron density. (auth)

10763 (AMRA-TR-63-33) ELECTRIC QUADRUPOLE INTERACTIONS IN RARE EARTH IONS. A. J. Freeman (Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.; Watertown Arsenal. Materials Research Lab., Mass.); and R. E. Watson (Bell Telephone Labs., Inc., Murray Hill, N. J.). Dec. 1963. 10p.

Electric quadrupole interactions in rare earth ions arising from electric field gradients due to valence electrons (q_{4f}) and/or crystal fields external to the ion (q_{lat}) are discussed. The contribution of the Sternheimer antishielding factors to both q_{4f} and q_{lat} are calculated for the Ce^{3+} ion using the method (based on the unrestricted Hartree-Fock formalism) reported earlier. The ionic antishielding factor (γ_∞) is –73.5 and it is found that the total ionic contribution to the electric field gradient can be comparable in magnitude (and may be opposite in sign) with the valence electron contribution (augmented by the internal antishielding factor). The possible relation of these results to the temperature dependence of measured electric quadrupole interactions is noted. (auth)

10764 (ANL-6797(p.464-8)) INVESTIGATION OF QUASI-ADIABATIC ATOMIC COLLISIONS BY FISSION PRODUCTS. P. Armbruster, H. Specht, and A. Vollmer (Munich. Technische Hochschule).

Fission products were used as a source of heavy ions in the investigation of the excitation mechanism of inner-shell ionization. The energies of the L x-ray quanta from light 78-Mev fission products and heavy 46-Mev products were compared for beryllium and copper targets. (R.E.U.)

10765 (CONF-381-2) ENERGY LOSS SPECTRA FOR CHARGED PARTICLES TRAVERSING METAL AND PLASTIC FILMS. R. D. Birkhoff (Oak Ridge National Lab., Tenn.). [1962]. Contract [W-7405-eng-26]. 27p.

From International Symposium on Physical Processes in Radiation Biology, Ann Arbor, Mich., May 1963.

The theory of Pines and Bohm that attributed energy losses in metals to the excitation of the conduction electron plasma is reviewed, together with its experimental verification. The search for the emission of monochromatic light from irradiated metals, indicating the decay by radiation of the conduction electron plasma, is also summarized. Experiments and theories on energy losses in carbon and collodion are discussed. (D.C.W.)

10766 (KAPL-M-FDF-4) MASS 1K—A PROGRAM TO CALCULATE THE MASS 1 FREE GAS THERMAL SCATTERING KERNEL. Francis D. Federighi (Knolls Atomic Power Lab., Schenectady, N. Y.). July 1963. Contract W-31-109-eng-52. 7p.

The program MASS 1K calculates the first four Legendre moments of the angular dependent mass-one free-gas thermal scattering kernel for an arbitrary set of input energies. Output is in binary form on magnetic tape. The formulas for the moments are given. (auth)

10767 (RTD-TDR-63-3076) RECOMBINATION AND ATTACHMENT IN IONIZED GASES. V. A. J. van Lint, J. Parez, M. E. Wyatt, and D. K. Nichols (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Dec. 1963. Contract AF29(601)-2779. 204p.

Experiments were performed to measure the coefficients for electron attachment, electron-ion recombination, electron-molecule collisions, and ion-ion recombination in important atmospheric gases and atmospheric impurities. The rate of disappearance of electrons (or ions) in the afterglow of a pulse of ionization produced by high energy electrons transversing the gas sample was observed. Most of the diagnostic measurements were performed by observing the phase shift and attenuation of an X-band microwave propagated through the ionized gas. Some experiments were performed with a 300 Mc resonating cavity that is sensitive enough to detect the effect of ions in the afterglow after the electrons have been attached. Results for N, O, He, Ne, Ar, NO_2, and NO are presented and discussed. The associated theory is also presented, together with the FORTRAN listing of a computer program for the reduction of ionized gas data. (auth)

10768 (TID-20116) FINAL STATE EFFECTS IN ATOMIC PROCESSES: PHOTODETACHMENT. John Gillespie (Columbia Univ., New York). [1963]. Contract [AT(30-1)-1808]. 24p.

A formalism that corrects Born approximation amplitudes for final state effects in atomic scattering and detachment processes is developed by use of Jost function enhancement factors. The method leads to soluble integral equations of the Omnès type. Application is made to the photodetachment of negative oxygen ions ($\gamma + O^- \rightarrow O + e^-$), yielding an improved fit to recent experimental data. The theory is compared with earlier work of Klein and Brueckner. (auth)

10769 (AEC-tr-6089) INTERACTION OF ATOMIC PARTICLES WITH THE SURFACE OF A METAL. U. A. Arifov. Translation of "Vzaimodeistvei Atomnykh Chastits s Poverkhnost'yu Metalla" (a publication of the Academy of Sciences, Tashkent, 1961). 232p.

This book presents an analysis and a review of studies of the collisions of atoms and ions with metallic surfaces.

Ion-electron, ion-ion, neutral-ion, and neutral-electron emission phenomena are considered along with the neutralization of ions on the metal surface. Particular attention is paid to the oscillographic method of double modulation for the investigation of various secondary and accompanying processes. (D.L.C.)

10770 (AEC-tr-6317) ANOMALOUS ROENTGEN-SCATTERING OF HEAVY ATOMS IN THE REGION OF THE K- AND L- EDGES ACCORDING TO THE DISPERSION THEORY OF WAVE MECHANICS. [PART] II. H. Eisenlohr and G. L. J. Mueller. Translated for Los Alamos Scientific Lab., N. Mex., from Z. Physik, 136: 511-33(1954). 24p.

A study is made of the scattered wave of an atom irradiated by x rays. Scattering formulas are derived for real atoms and applied to two scattering elements Te and W. The angular dependence of the dispersion for Te was calculated in the region between the K- and L- edges. The frequency dependence of the dispersion of Te and W was also studied. The calculated photoabsorption curves are in good agreement with experimental data. (D.L.C.)

10771 THE KINETICS OF WAVES IN A PLASMA. G. I. Suramlishvili. Dokl. Akad. Nauk SSSR, 153: 317-20 (Nov. 11, 1963). (In Russian)

The kinetic equations for plasma waves are derived by expanding the lagrangian for a collisionless plasma in powers of the amplitudes of oscillation. Some of the characteristics of several wave-wave interactions in a weakly turbulent plasma are described from these equations: the decay of one wave into two waves, the coalescence of two waves into one (3-plasmon process), and the scattering of one wave by another (4-plasmon process). The kinetic equations for a weakly turbulent plasma have the same form as those for the scattering of phonons in condensed media. The interaction of ion-acoustical vibrations with electronic Langmuir oscillations is similar to the absorption of sound by the thermal phonons of a solid. (TTT)

10772 IONIZATION OF A SUPERSONIC STREAM OF MERCURY VAPOR BY A HYDROGEN ION BEAM. A. D. Abramenkov, V. F. Rybalko, and Ya. M. Fogel' (Khar'kov State Univ.). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 5, 76-81(1963). (In Russian)

Descriptions are given of a multicharged ion beam developed from a plasma produced by ionization of a supersonic stream of mercury vapor by a hydrogen ion beam. It is shown that the beam current is limited by the volume charge in the region between the ionization zone and drawing-off probe. (tr-auth)

10773 DISCREPANCY IN ENERGY TRANSFER BETWEEN MEDIUM ENERGY NOBLE-GAS IONS AND NEUTRAL ATOMS BOMBARDING METAL SURFACES. P. Mahadevan, J. K. Layton, A. R. Comeaux, and D. B. Medved (General Dynamics/Astronautics, San Diego, Calif.). J. Appl. Phys., 34: 2810-12(Sept. 1963).

Experiments using thermoelectric detectors for neutral particles showed differences in the energy transfer properties of noble-gas ions and neutral atoms. The focused and collimated beams of ions and atoms bombard a platinum-receiving disk spot welded to the thermojunction, formed of Chromel and Constantan wires. Neutral atoms and ions of Ne and Ar were studied in the energy range 500 to 2500 ev. For ions, the fraction of the kinetic energy used to generate thermo-emf in the detector was observed to be independent of their incident kinetic energy. However, for the neutral atoms, the energy transfer coefficient was found to be a monotonically increasing function of kinetic energy always less than that for ions. No attempt was made to measure the absolute energy transfer coefficients. This discrepancy was qualitatively explained by the experimental observation that energetic neutral atoms are specularly reflected more than ions of the same species and kinetic energy from the platinum disk of the detector. (auth)

10774 RANGE AND DAMAGE EFFECTS OF TUNNEL TRAJECTORIES IN A WURTZITE STRUCTURE. J. R. Beeler, Jr. and D. G. Besco (General Electric Co., Cincinnati). J. Appl. Phys., 34: 2873-8(Sept. 1963).

Machine calculation results on some specific effects that the tunneling of energetic atoms in a crystal lattice enforces on the range and damage productivity of these atoms are described. Tunneling refers to the alignment of an energetic atom trajectory with the axes of straight, open cylindrical avenues in a crystal lattice. The stopping power for a tunnel trajectory is anomalously small and the range anomalously large. The particular case of 2-kev beryllium and 6-kev oxygen primary knock-on atoms (PKA) in BeO (wurtzite structure) is treated. With respect to the inducement of tunneling, the results indicate that the initial azimuthal direction of a PKA in a plane parallel to the wurtzite basal plane is a more important parameter than the position of its starting position on a line normal to this plane. Oxygen PKA manifested quasitunnel behavior when the azimuthal angle was within ±10° of a tunnel direction and beryllium PKA manifested this behavior over a ±25° sector centered on a tunnel direction. (auth)

10775 EFFECTS OF A GUARDRING UPON LOW-ENERGY SPUTTERING YIELDS OF FLAT, SINGLE-CRYSTAL GOLD TARGETS. W. C. Kreye (Electronic Research Branch, Wright-Patterson AFB, Ohio). J. Appl. Phys., 34: 2897-2902(Sept. 1963).

Spectrometric sputtering yield measurements were performed upon flat, single-crystal gold targets in a supported argon plasma, and the results are compared with those obtained when a large copper guardring was placed about the target. After the results are adjusted to similar discharge conditions, the relative yields without the guardring are greater for all three orientations, (100), (110), and (111). The increase is attributed to the formation of a curvature to the Langmuir layer immediately about the gold target when the guardring is not used. This introduces ions that strike the gold surface at oblique incidence angles. The square root of the relative yield is plotted against the target voltage, and the curves are found to be linear in the range of 40 to 70 v. The intercepts E_E of the extrapolated linear portions of the two curves, with and without a guardring, are found to be equal for each orientation. These values, at 9 μ of argon, are 33, 28.5, and 35 ev for the (100), (110), and (111) faces, respectively. These values do not include the subtractive correction for the plasma potential whose measured value is approximately 15 ev. For the (100) and (111) faces, the calculated differences $[E_E - E_E(100)]$ are proportional to the corresponding differences in the binding energies of a surface atom that is in an upper, complete lattice plane. (auth)

10776 TEMPERATURE DEPENDENCE OF BeO TUNNELING STRUCTURES. C. K. Chow (Burroughs Corp., Paoli, Penna.). J. Appl. Phys., 34: 2918-19(Sept. 1963).

Experimental results on the temperature dependence of a Be–BeO–Au tunneling structure are correlated with theoretical calculations. The tunnel current was measured at 100 to 400°K with an applied voltage of 1 v. (C.E.S.)

10777 NOTES ON RESOLUTION IN SCATTERING MEASUREMENTS. P. Kusch (Columbia Univ., New York). J. Chem. Phys., 40: 1-4(Jan. 1, 1964).

The instrumental factors that determine the resolution of an atomic beam apparatus in the measurement of total scattering cross sections are discussed. A definition of resolution as the minimum scattering angle for which the efficiency of detection of scattering is 50% is proposed. (auth)

10778 SOME EXCITED STATES OF THE HYDROGEN MOLECULE. I. $^1\Pi_u(1s2p\Pi)$ AND $^3\Pi_u(1s2p\Pi)$. J. C. Browne (Univ. of Texas, Austin). J. Chem. Phys., 40: 43-6(Jan. 1, 1964).

Theoretical potential curves, spectroscopic constants, and expectation values for some one-electron operators are given for the $^3\Pi_u(1s2p\Pi)$ (metastable) and $^1\Pi_u(1s2p\Pi)$ states of the hydrogen molecule. Total energies of 0.7145 and 0.7334 au are obtained for $^1\Pi_u$ and $^3\Pi_u$, respectively. The experimental total energies are 0.7186 and 0.7381 au for $^1\Pi_u$ and $^3\Pi_u$, respectively. The maximum in the potential curve of the $^1\Pi_u$ state was found to be much smaller and to occur at a larger internuclear separation (0.02 ev at $R \approx 8.5$ au) than estimated by previous theoretical calculations (0.1 ev at $R \approx 4.5$ au). (auth)

10779 SUDDEN APPROXIMATION APPLIED TO ROTATIONAL EXCITATION OF MOLECULES BY ATOMS. I. LOW-ANGLE SCATTERING. K. H. Kramer and R. B. Bernstein (Univ. of Wisconsin, Madison). J. Chem. Phys., 40: 200-3(Jan. 1, 1964).

The sudden approximation is applied to the calculation of transition probabilities and cross sections for rotational excitation and scattering of homonuclear diatomic molecules by atoms. The influence of the anisotropy and strength of the long-range attractive part of the interaction potential on the scattering at low angles is considered. The results illustrate the main features of the method applied to inelastic molecular collisions in general, and demonstrate its advantage over the first-order perturbation approximation. Measurements of low-angle differential inelastic scattering cross sections would yield directly the anisotropy of the long-range attractive potential. (auth)

10780 ELECTRONIC ENERGY OF THE HYDROGEN MOLECULE GROUND STATE BY THE LOCAL-ENERGY METHOD. D. K. Harriss and A. A. Frost (Northwestern Univ., Evanston). J. Chem. Phys., 40: 204-7(Jan. 1, 1964).

The least-squares local-energy method was applied to the hydrogen molecule in great detail. Equations are given for the Hamiltonian operator and local energy for diatomic molecules in the mixed interelectronic-confocal elliptic coordinate system. Wavefunctions with up to 22 terms and larger numbers of points are considered and it is shown that both lead to values for the dissociation energy that are within ±0.0001 hartrees of the exact value, 0.1744 hartrees. (auth)

10781 CALCULATED SCATTERING CROSS SECTIONS FOR He–He AT THERMAL ENERGIES. R. B. Bernstein and F. A. Morse (Univ. of Wisconsin, Madison and Univ. of Michigan, Ann Arbor). J. Chem. Phys., 40: 917-18(Feb. 1, 1964).

Elastic scattering cross sections were calculated for He–He interactions at thermal energies. The calculation is based on a potential constructed by joining a short-range repulsion via a Morse function to a long-range attraction. The results are illustrated graphically. The experimental Q's were higher than the predicted values. (P.C.H.)

10782 g-SUM RULE AND THE LEVELS OF Eu II. B. G. Wybourne (Argonne National Lab., Ill.). J. Opt. Soc. Am., 54: 267(Feb. 1964).

The failure of the theoretical sum to agree with the experimental g sums for levels in Eu II formed by couplings of a 6s, 6p, or 5d electron to the $4f^7(S^8)$ core is shown to be due to an error in the theoretical sum. A correction to the theoretical g sum for breakdown of Russell-Saunders coupling in the core is suggested. (R.E.U.)

10783 COMMENTS ON "THE ISOTOPE EFFECT IN THE SPECTRUM OF THORIUM." G. W. Charles (Oak Ridge National Lab., Tenn.). J. Opt. Soc. Am., 54: 267-8 (Feb. 1964).

Isotopic shift data are given for classified and unclassified lines of thorium I and II for shifts between Th^{229} and Th^{232}. Classification of spectral lines is discussed. (R.E.U.)

10784 RECENTLY DISCOVERED AUTO-IONIZING STATES OF KRYPTON AND XENON IN THE λ380-600-Å REGION. R. P. Madden and K. Codling (National Bureau of Standards, Washington, D. C.). J. Opt. Soc. Am., 54: 268-9(Feb. 1964).

The absorption of photons of energies above first ionization in krypton and xenon in the spectral region of 380 to 600 Å is discussed. (R.E.U.)

10785 OBSERVATION OF OPTICALLY FORBIDDEN TRANSITIONS IN THE CONTINUUM OF THE RARE GASES BY ELECTRON ENERGY LOSS MEASUREMENTS. J. Arol Simpson, S. R. Mielczarek, and J. Cooper (National Bureau of Standards, Washington, D. C.). J. Opt. Soc. Am., 54: 269-70(Feb. 1964).

The electron scattering intensity in the forward direction as a function of energy loss was studied for Ne, Ar, Kr, and Xe. Optically forbidden excitations were observed. (R.E.U.)

10786 ENERGY DISSIPATION OF ELECTRON BEAMS IN MATTER. Yohta Nakai (Japanese Assn. for Radiation Research on Polymers, Osaka). Japan. J. Appl. Phys., 2: 743-56(Dec. 1963).

The spatial distributions of energy dissipation of electrons in beryllium, aluminum, copper, silver, and lead were obtained experimentally for well collimated electron beams of a few Mev generated from a Van de Graaff accelerator. Comparing with the Spencer theory, it is found that the experiment and the theory are generally in agreement except in shallow and in very deep penetration. The discrepancies between the experiments and the theory might be attributable to neglecting the effects of secondary electron and of electron straggling in the theory. (auth)

10787 MEASUREMENTS OF THE DECAY RATE OF IONS PRODUCED BY GASEOUS-PHASE ELECTRON SHOCK. G. V. Karachevtsev and V. L. Tal'roze (Inst. of Chemical Physics, Academy of Sciences, USSR). Kinetika i Kataliz, 4: 923-6(Nov.-Dec. 1963). (In Russian)

The theoretical principle of the method for investigating the kinetics of the fast decay of primary ions produced by electron shock was formulated. The scheme of the source is shown, and the comparatively simple problem of two fragments (ionized and neutral) was analyzed. (R.V.J.)

10788 EMISSION OF ULTRA-VIOLET RADIATION FROM METALS BY ALKALI-POSITIVE IONS. Rafi Mohammed Chaudhri, Akhtar Jehan, and M. Munawar Chaudhri (High Tension and Nuclear Research Lab., Lahore, West Pakistan). Nature, 201: 284-5(Jan. 18, 1964).

Radiation emitted from Al bombarded by K^+ ions of energies in the range 2–12 kev is discussed. It was observed that the intensity of the radiation increases rapidly with decreasing wavelength below 2500 Å. Its intensity at about 2100 Å is nearly 120 times larger than at 2500 Å. The intensity of the radiation was also found to rise with ion energy. A spectral intensity distribution curve of the radiation emitted from Al by K^+ ions is illustrated. (P.C.H.)

10789 A NEW METHOD TO MEASURE THERMAL ELECTRON ATTACHMENT CROSS-SECTIONS AND THERMAL DIFFUSION COEFFICIENTS IN GASES. G. Cavalleri, E. Gatti, and P. Principi (Centro Informazioni Studi Esperienze, Milan). Nuovo Cimento (10), 31: 302-9(Jan. 16, 1964).

The new method employs a recently realized gas-amplified scintillation chamber. The working of this light chamber is based on the decay of excited states caused by secondary electrons, obtained by Townsend local multiplication of primary electrons due to an ionizing particle. The multiplication is obtained through the application of a damped radiofrequency oscillation of an electric field, produced by a pulse generator triggered by the ionizing event. The average intensity of the amplified light pulses so obtained is measured by means of a multiplier phototube connected, through an amplifier, to a multichannel pulse-height analyzer. By inserting known delays between the time of occurrence of the primary ionizing event and the application of the amplification pulse, the centroid of the pulse-amplitude spectrum shifts towards lower values. The ratio of the centroid values corresponding to spectra with and without delays, gives the percentage of the electrons surviving the attachment and the diffusion to the walls. A plot of this ratio versus time delays, gives a rate of decay that is due to electron attachment and diffusion to the walls. This electron-density sampling method has the characteristic of not requiring a drift electric field, essential in all other methods and so it is possible to measure attachment cross sections for thermal electrons, also in mixtures of noble gases with few impurities. In this case the rate of electron decay due to diffusion to the walls can be measured independently by working with pure noble gases. These measurements allow a direct evaluation of the diffusion coefficient for thermal electrons that is not possible by other methods. Another advantage is inherent to the linear light amplification up to factors of 10^6, which allows measurements also when starting with very low ionization densities. Experiments were carried out using ionizing events due to Po^{210} α particles whose primary scintillation was detected by two multiplier phototubes in coincidence. Other ionizing events can be used, such as a flash of x rays, to obtain a diffused low-density ionization at a known initial time. (auth)

10790 EXPERIMENTAL MEASURE OF THE DIFFUSION COEFFICIENT FOR THERMAL ELECTRONS IN PURE NEON, USING AN ELECTRON-DENSITY SAMPLING METHOD. G. Cavalleri, E. Gatti, and P. Principi (Centro Informazioni Studi Esperienze, Milan). Nuovo Cimento (10), 31: 318-24(Jan. 16, 1964).

By the new electron-density sampling method described previously, employing the recently realized light chamber, the reduced diffusion coefficient D_0 was measured for thermal electrons in pure neon. The first direct experimental value $D_0 = (1670 \pm 50)$ cm^2/s is in agreement with that deduced from the collision probability P_c for momentum transfer of thermal electrons, using the P_c obtained by Phelps, Fundingsland, and Brown by elaboration, with an approximate method, of the results of microwave measurements. (auth)

10791 APPROXIMATIONS TO THE DIRAC DENSITY MATRIX. K. J. Le Couteur and M. K. Roy (Australian National Univ., Canberra). Phys. Letters, 8: 37-8(Jan. 1, 1964).

A modified statistical approximation to the density matrix for the case of nonuniform density is proposed. (D.C.W.)

10792 DERIVATION OF THE MODIFIED BLOCH EQUATIONS FOR SPIN SYSTEMS. J. Korringa (Faculté des Sciences, Besancon, France), J.-L. Motchane, P. Papon, and A. Yoshimori. Phys. Rev., 133: A1230-4 (Mar. 2, 1964).

A new form of the equations for the time-dependent statistical matrix of a spin system is used to derive the modified Bloch equations, without considering details of the relaxation mechanism. A number of restrictive conditions are imposed on the system, most of which agree well with known limitations of the applicability of the modified Bloch equations. In order to avoid complications, only spins one-half are considered. The theory does not apply to the case where the relaxation is anisotropic but where the constant field and an applied rotating field are comparable in magnitude. (auth)

10793 FREQUENCY-DEPENDENT RELAXATION TIME OF ELECTRON-PHONON SYSTEMS. II. EFFECTS OF FINITE LIFETIME OF THE PHONONS. A. Ron (Princeton Univ., N. J.) and N. Tzoar. Phys. Rev., 133: A1378-81(Mar. 2, 1964).

A previous theory of the frequency-dependent relaxation time for a simple model of metal assuming the phonons to have infinite lifetime is investigated from a more sophisticated point of view. The effects of low temperature are reconsidered and the effect of the finite lifetime of the phonons is included. The Green's function technique is used to obtain the response of the electron-phonon system to an oscillating electric field. The treatment, which employs the time-dependent currents correlation function, does not have the time scale restriction of the usual transition probability approach and does give a proper description of the time-dependent collective effects. (auth)

10794 THE DIFFERENCE IN THE INTERMOLECULAR POTENTIALS OF H_2 AND D_2. A. K. Barua and A. Saran (Indian Assn. for the Cultivation of Science, Calcutta). Physica, 29: 1393-6(Dec. 1963).

The quantity $\delta = (\epsilon_H - \epsilon_D)/\epsilon_D$, where ϵ_H and ϵ_D are the depths of the intermolecular potentials (L-J 6:12 type) of H_2 and D_2, respectively, as calculated from the experimental second virial coefficient data, shows a temperature dependence. An explanation is proposed for the temperature dependence of δ by considering the temperature dependence of the polarizabilities of H_2 and D_2. (auth)

10795 ON HYPERFINE INTERACTION IN Re(VI). N. S. Garifyanov (Inst. of Physics and Tech., Kazan Branch, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 1819-21(Dec. 1963). (In Russian)

The anisotropic hyperfine structure of EPR lines from nuclei of the Re^{185} and Re^{187} isotopes is investigated at a frequency $\nu = 9320$ Mc and temperature 77°K in sulfuric acid and dioxane low temperature glasses. From an analysis of the hyperfine structure spectra, values of the anisotropic hyperfine splitting constants can be derived: $A_{||} = 480$ Oe, $A_\perp = 400$ Oe, and also the values $g_{||} = 1.90$ and $g_\perp = 1.77$. (auth)

10796 STUDIES OF LILIENFELD EMISSION. C. Radeloff. Thesis, Berlin, Technische Hochschule, 1961. 53p. $2.00(Gmelin, AED-DISS. 61-353).

The temperature and pressure dependence of the intensity of Lilienfeld emission is studied. Energy and angular distributions, polarization, and absolute light yield were measured for W, Ta, Mo, Ti, Pt, Cs, Na, and Ag. The properties of Lilienfeld emission are compared with those of x rays, bremsstrahlung, and transition radiation. Results indicate that Lilienfeld emission for faster electrons (>5 kev) is identical with transition radiation as calculated by Ginsburg and Frank. (Gmelin Inst.)

10797 ELECTRON PRODUCTION IN GASES AND ON SURFACES BY SLOW IONS AND NEUTRAL PARTICLES. E. Meyer. Thesis, Würzburg, Ger., Universität, 1962. 53p. $2.00 (Gmelin, AED-DISS. 62-549).

Electron production by slow charged and neutral particles in rare gases, H_2, and N_2 was measured by collision experiments with particle energies between 30 and 300 ev. Charge exchange and ionization cross sections as a function of energy are given. The electron yield of surfaces was measured for various metals. (Gmelin Inst.)

10798 ATOMIC PHYSICS. Roy Weinstein (Northeastern Univ., Boston). Book I of "Nuclear Engineering Fundamentals." New York, McGraw-Hill Book Company, 1964. 196p.

Atomic concepts are introduced by means of the elementary laws of chemistry. Introductory material on mechanics, electromagnetism, and relativity are included. Crucial experiments leading to the present knowledge of atomic physics are outlined. Properties of hydrogen and heavier atoms are also discussed. Appendices containing conversion factors and physical constants, chemical data, atomic masses, and elementary mathematical methods are also included. (C.E.S.)

10799 DE-ACTIVATION OF NEON METASTABLES BY H_2. Thomas C. Marshall (Columbia Univ., New York). 9p. (CONF-364-7)

From 16th Annual Gaseous Electronics Conference, Pittsburgh, Oct. 1963.

The cross section for the inelastic reaction $Ne^* + HE \rightarrow Ne + H + H$ was investigated. The experiment was carried out by means of a cw gaseous discharge in a mixture of Ne and H_2 gas. (C.E.S.)

Cosmic Radiation

10800 (LNF-63/54) RACCOLTA DELLE COMUNICAZIONI PRESENTATE AL CONGRESSINO ANNUALE DELL'ISTITUTO NAZIONALE DI FISICA NUCLEARE, FRASCATI, 6-7-8-9 MAGGIO 1963. SESSIONE RAGGI COSMICI. (Compilation of the Papers Presented at the Annual Congress of the Istituto Nazionale di Fisica Nucleare, Frascati, May 6-9, 1963. Cosmic Radiation Session). (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). June 1963. 37p.

Thirteen papers presented at the cosmic radiation session of the Annual Congress of the Istituto Nazionale di Fisica Nucleare are compiled. Separate abstracts were prepared for each paper. (J.S.R.)

For abstracts of individual papers see: 10217, 10338, 10339, 10378, 10379, 10380, 10801, 10802, 10803, 10804, 10805, 10806, and 11027.

10801 (LNF-63/54(p.4-7)) RISULTATI PRELIMINARI SUL FLUSSO DI NEUTRONI SECONDARI PRODOTTI NELLE INTERAZIONI DEI RAGGI COSMICI NELL'ATMOSFERA. (Preliminary Results on the Secondary Neutron Flux Produced in the Interaction of Cosmic Rays in the Atmosphere). G. Boella, G. Degli Antoni, C. Dilworth, E. Rocca, and L. Scarsi (Milan. Università. Istituto di Scienza Fisica and Italy. Istituto Nazionale di Fisica Nucleare, Milan).

A series of measurements on the neutron flux in the atmosphere is being made with the purpose of determining both the absolute intensity and the energy spectrum in order to estimate the contribution of the decay of albedo neutrons to the formation of the Van Allen belts. Preliminary results obtained on the third balloon flight are reported. The detector used is based on a pair of thermal neutron counters of plastic–boron scintillators coupled with photomultipliers. One of the scintillators is enriched 96% in B^{11} and the other to 92% in B^{10}. The scintillators are surrounded by a hemisphere of paraffin 6 cm in radius. The response is almost uniform for thermal energies up to about 10 Mev with a maximum in the region of 500 kev. The balloon was launched on April 25, 1963, and reached an altitude of 38 km (equivalent to 3.6 g/cm^2 of residual atmosphere). The results are graphed and compared with those from the two previous flights. The analysis of the data gave preliminary values of 90 ± 10 g/cm^2 as the atmospheric depth for the maximum neutron counts and 175 ± 10 g/cm^2 as the mean attenuation path in the atmosphere between 200 and 600 g/cm^2. (J.S.R.)

10802 (LNF-63/54(p.18-23)) INTERCALIBRAZIONE DEI RIVELATORI EUROPEI DI NEUTRONI E STUDIO DELLE PROPRIETA' DELLA COMPONENTE NUCLEONICA DEI RAGGI COSMICI. (Intercalibration of European Neutron Detectors and Study of the Properties of the Nucleon Component of Cosmic Radiation). F. Bachelet, P. Balata, and N. Iucci (Rome. Università. Istituto di Fisica).

The desirability for the intercalibration of European neutron detectors in the study of the time variation of cosmic radiation is considered, and the progress made in the project is indicated. Two experiments to be made during the intercalibration project are measurement of the atmospheric attenuation length for the nucleon component and measurement of the multiplication. The theory of the first measurement is discussed. The neutron detector used in the multiplication measurement is shown, and the data analysis is indicated. The results obtained at Rome at the stationary and mobile station are tabulated. (J.S.R.)

10803 (LNF-63/54(p.28)) MISURATORE DI PLASMA SOLARE. (Solar Plasma Meter). F. Melchiorri, G. Pizzella (Rome. Università. Istituto di Fisica); R. Habel, and T. Letardi (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Naionali, Frascati).

The possibility of using CdS crystals to measure solar plasma was investigated. A 100-v battery at the ends of a crystal ($3 \times 3 \times 0.3$ mm^3) generates a current that varies almost linearly with the flux of incident energy. An analysis shows that the minimum flux measurable is $\sim 5 \times 10^{-4}$ erg/cm^2 sec, which corresponds to a background flux of 10^{-10} amp. A current of $\sim 10^{-8}$ amp will circulate in the crystal in the case of incident protons. It appears that the measurement of the proton component is feasible with CdS crystals used in connection with a spherical electrostatic deflector that focuses electrons or protons in an angle of 0.2 steradians and in an energy band around 10% of the mean energy. (J.S.R.)

10804 (LNF-63/54(p.29-30)) RICERCA SULL'ORIGINE DELLA COMPONENTE FOTONICA A BASSA EN-

ERGIA IN ATMOSFERA. (Research on the Origin of the Low-Energy Photon Component in the Atmosphere). D. Brini, U. Ciriegi, F. Fuligni, A. Gandolfi, and F. M. Gomide (Italy. Consiglio Nazionale delle Ricerche, Bologna).

A very intense component of very low-energy photons was recently detected in the atmosphere. An experiment to determine the origin of this component is proposed based on the detection of a latitudinal effect. The statistics of the detectors to be used in balloon ascents are given. (J.S.R.)

10805 (LNF-63/54(p.31)) STUDIO DELLE VARIAZIONI DI UNA SERIE TEMPORALE MEDIANTE L'INTERPRETAZIONE DEL SUO AUTOCORRELOGRAMMA. (Study of the Variations of a Time Series Using the Interpretation of the Autocorrelogram). M. Galli, F. Palmonari, and P. Randi.

With the purpose of applying the results to the study of the variations of cosmic radiation, the manner of interpreting the autocorrelogram of a time series was studied. The following results were found. If, with suitable numerical filters, a frequency or a frequency band can be sharply separated from the autocorrelogram, this represents the autocorrelogram of that part of the series which is formed from that frequency or that frequency band. From the initial amplitude of an oscillation of given frequency contained in the autocorrelogram, the mean square of the amplitude of that frequency contained in the series can be detected. If, in a series, the amplitude of an oscillation of given frequency appears modulated, its autocorrelogram is given by an oscillation of the same frequency whose modulating frequency is the autocorrelogram of the modulating function of the oscillations contained in the series. (tr-auth)

10806 (LNF-63/54(p.32)) VARIAZIONI DIURNE E SEMIDIURNE TRANSITORIE E STAZIONAIRE DEI RAGGI COSMICI. Relazione su richerche in corso. (Transitory and Stationary Diurnal and Semidiurnal Variation of Cosmic Radiation). M. Galli, F. Palmonari, and P. Randi.

The autocorrelation method was used to analyze the data on the total component of cosmic radiation under 450 g/cm^2 received at Bologna scintillation detectors from March 1 to March 31, 1962. The following results were obtained. The mean square amplitude of the diurnal variation is 0.9%, remarkably lower than the generally accepted value. A diurnal oscillation with nonpersistent character is present at 23:30 ±5 min with mean-square amplitude of 1.8%. A stationary diurnal variation, occurring each day with the same amplitude and phase, exists whose amplitude can be assigned with upper limit of 0.9%. A semidiurnal wave with amplitude of 0.7% is present in an unequivocal manner, comparable to the stationary diurnal oscillations. (tr-auth)

10807 REMARK OF THE ANGULAR DISTRIBUTION OF PARTICLES IN HIGH ENERGY JETS. Kacper Zalewski (Inst. of Physical Chemistry, Polish Academy of Sciences, Krakow). Acta Phys. Polon., 24: 823-5(Dec. 1963).

It is shown that the theoretical probability distribution of particles in high-energy jets is incompatible with experimental data. (C.E.S.)

10808 THE POSSIBILITY OF USING NEW SYSTEMS OF GEIGER COUNTERS FOR THE CONTINUOUS RECORDING OF COSMIC RAYS. Ya. L. Blokh (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 2: 960-2(1962).

The requirements and limitations of systems based on Geiger counters and plastic scintillators are discussed. (R.E.U.)

10809 FLUCTUATIONS OF COSMIC-RAY INTENSITY DURING A FORBUSH DECREASE. L. I. Dorman, E. V. Kolomeets, L. V. Kozak, V. T. Pivneva, and G. A. Sergeeva (Kazakh State Univ., USSR). Geomagnetism Aeronomy, 3: 293(1963).

The peaks of increased intensity at the time of many magnetic storms against a background of sharp decrease in cosmic-ray intensity (Forbush decrease) are discussed. (R.E.U.)

10810 UNDERGROUND RECORDING OF COSMIC RADIATION FOR THE PURPOSE OF SOLVING CERTAIN GEOLOGICAL PROBLEMS. Ya. L. Blokh, V. M. Bondarenko, and A. G. Tarkhov (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR and Moscow Geological Exploration Inst.). Geomagnetism Aeronomy, 3: 320-3(1963).

Rock thickness, mass, and irregularities in density are determined by underground recording of the μ-meson component of cosmic radiation. The apparatus and some results are described. (R.E.U.)

10811 ALPHA PARTICLE AND PROTON FLUXES OF THE PRIMARY COSMIC RADIATION AND THEIR TIME VARIATIONS. E. Waibel (Max-Planck-Institut für Aeronomie, Lindau, Ger.). J. Atmospheric Terrest. Phys., 24: 779-84(Sept. 1962).

The primary integral fluxes of the total cosmic radiation, protons, and alpha particles were determined from measurements with proportional counters at balloon altitudes over Germany. The flights covered times of different solar activity. The ratio of relative amplitudes of the time variations is found to be 2.1 ± 0.3 for the total radiation as well as for the alpha particle component with respect to the neutron recordings at ground level. The total radiation at 0 g/cm^2 consists of about 13 per cent of alpha particles. (auth)

10812 SOLAR PROTON SPECTRUMS IN THE EVENTS OF NOVEMBER 12 AND 15, 1960. K. W. Ogilvie and D. A. Bryant (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 69: 393-8(Feb. 1, 1964).

A previously proposed exponential rigidity spectrum, which provides a good empirical fit to solar proton data over a wide range of rigidity and during widely different events, is discussed with respect to the events of November 12 and 15, 1960. It is found that for the November 12 event an exponential rigidity spectrum does not fit the observations, owing to the presence of a relatively large number of low-energy protons, and that data obtained late in the November 15 event are consistent with an exponential rigidity spectrum. It is suggested that the difference in character of the spectrums observed in these two events is due to a flux of low-energy protons arriving at the earth on November 12 with the solar plasma responsible for concurrent geomagnetic disturbances. The flights made late in the November 15 event were during a geomagnetically quiet time. (auth)

10813 THE EDGE OF THE POLAR PLATEAU FOR GALACTIC COSMIC RAYS AND THEIR CHARGED ALBEDO. J. A. Van Allen and W. C. Lin (State Univ. of Iowa, Iowa City). J. Geophys. Res., 69: 531-4(Feb. 1, 1964).

Previously reported data on the edge of the polar plateau for galactic cosmic rays and their charged-particle secondaries (albedo) were recalculated, and

a value of L = 2.9 was found for the edge of the plateau. (C.E.S.)

10814 AN EMPIRICAL RELATIONSHIP BETWEEN PARTICLE FLUX, ENERGY SPECTRUM, AND RADIO WAVE ABSORPTION DURING A POLAR CAP EVENT. R. Parthasarathy (Geophysical Inst., College, Alaska) and D. Venkatesan. J. Geophys. Res., 69: 549-52(Feb. 1, 1964).

An empirical relation for cosmic radio wave absorption during a PCA event is derived as a function of ionospheric particle flux and energy spectra. (C.E.S.)

10815 RATIO OF ELECTRONS TO POSITRONS IN THE PRIMARY COSMIC RADIATION. James A. De Shong, Jr. (Argonne National Lab., Ill.), Roger H. Hildebrand, and Peter Meyer. Phys. Rev. Letters, 12: 3-6(Jan. 6, 1964).

An experiment is reported in which the positron-electron ratio of primary cosmic radiation was measured as a function of energy to obtain information on the nature of the electron source. The instrument used in the balloon-flight measurements consists of a permanent magnet (6000 gauss), a spark chamber telescope, and a tantalum plate spark chamber. The energy interval was 50 to 1000 Mev. The observed primary electrons are tentatively assigned as of galactic origin. (R.E.U.)

10816 INTERPRETATION OF DATA OBTAINED BY ROCKET MEASUREMENTS IN THE UPPER ATMOSPHERE USING A THERMO-LUMINESCENT PHOSPHOR. T. V. Kazachevskaya and G. S. Ivanov-Kholodnyi. Planetary Space Sci., 11: 1489-92(Dec. 1963).

Interpretations are presented of rocket measurements made during the solar eclipse of Feb. 15, 1961, of the intensity of the penetrating radiation in the lower ionosphere at 70 to 100 km using a thermoluminescent phosphor $CaSO_4$(Mn). Unexpected signals from the phosphor, two orders higher than expected from solar x radiation and Lyman-α radiation, are investigated. (R.E.U.)

10817 THE VAN ALLEN PARTICLES. H. Elliot (Imperial Coll. of Science and Tech., London). Rept. Progr. Phys., 26: 145-80(1963).

The theory of the motion of Van Allen particles trapped in the geomagnetic field is reviewed, and recent information (up to November 1962) on the spatial distribution and energy spectra of the trapped particle population is summarized. The temporal intensity variations of the particle flux, associated with geomagnetic activity, are discussed in relation to the problem of the origin of the particles. The review includes a brief account of the effects on the radiation belts of the Argus and Starfish high altitude nuclear explosions. (auth)

10818 SEA LEVEL COSMIC RAY INTENSITY AND THRESHOLD RIGIDITY. Arne Eld Sandstroem (Uppsala Univ.), Martin A. Pomerantz, and Bengt-Olov Groenkvist. Tellus, 15: 184-93(May 1963).

The intensity of the nucleon component was measured with a shipboard neutron monitor during a number of voyages between Oct. 1956 and March 1959. After reduction and normalization, the intensity was plotted as a function of the rigidity value computed by Quenby and Wenk. Four limited regions excepted, the point distribution is confined to a comparatively narrow band corresponding to the errors of measurement. Corrected threshold values are given for the regions in which the points fall outside the general distribution. These regions are all inside the geomagnetic latitudes between which Quenby and Wenk had to interpolate for the penumbral effect. (auth)

10819 EFFECTS OF THE ORIGIN OF PRIMARY PARTICLES IN ELECTRON-PHOTON CASCADE SHOWER ON THE FUNCTION OF THE ANGULAR AND SPATIAL DISTRIBUTION. V. V. Guzhavin and I. P. Ivanenko. Vestn. Mosk. Univ., Ser. III, Fiz., Astron., No. 5, 3-7(Sept.-Oct. 1963). (In Russian)

The influence of cascade particle origin on the angular and spatial distribution functions at various depths is analyzed. It is shown that with the approximation $E_0 \neq \infty$ the distribution functions for a shower formed by high-energy primary photons differs considerably from the similar functions for showers formed by primary electrons. (tr-auth)

10820 POLARIZATION OF COSMIC RAY μ^+-MESONS. T. L. Asatiani, V. M. Krishchyan, and R. O. Sharkhatunyan (Inst. of Physics, Erivan). Zh. Eksperim. i Teor. Fiz., 45: 1717-19(Dec. 1963). (In Russian)

A multi-plate cloud chamber is employed for measuring the degree of polarization of 0.3 and 1.45-Bev cosmic muons. Values of 0.23 ± 0.09 and 0.34 ± 0.09, respectively, are obtained. (auth)

10821 ALTITUDE VARIATION OF VERTICAL EXTENSIVE ATMOSPHERIC SHOWERS IN THE UPPER PART OF THE ATMOSPHERE. R. A. Antonov, Yu. A. Smorodin, and Z. I. Tulinova (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 45: 1865-74 (Dec. 1963). (In Russian)

Experiments carried out in the upper part of the atmosphere yield data on the fluxes and spectra of vertical extensive atmospheric showers and also data on the spatial distribution of particles in the showers. The altitude dependence of showers with $\sim 10^6$ particles derived on the basis of these data indicate a high degree of energy dissipation in the interaction of particles with energies $\sim 10^{15}$ ev that initiate the showers. (auth)

10822 COMPOSITION OF NUCLEAR-ACTIVE COMPONENT OF COSMIC RAYS IN THE ATMOSPHERE. N. L. Grigorov (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 45: 1919-25(Dec. 1963). (In Russian)

The flux of high-energy pions in the atmosphere at various heights is calculated. It is shown that at mountain heights and at sea level pion fluxes, according to conservative estimates, should comprise 25 and 40% of the nucleon fluxes at energies of 10^{11} and 10^{12} ev, respectively. (auth)

10823 LATERAL DISTRIBUTION OF NUCLEAR-ACTIVE PARTICLES IN EXTENSIVE AIR SHOWERS. E. V. Gedalin (Inst. of Physics, Academy of Sciences, Georgian SSR). Zh. Eksperim. i Teor. Fiz., 45: 1967-9 (Dec. 1963). (In Russian)

It is shown that if diffraction scattering is described in accordance with the Regge pole hypothesis then the mean square angles and radii of nuclear-active particles with energies $E \geq 10^{12}$ ev in the core of an extensive air shower are determined only by the emission angles of the secondary particles during multiple production events. (auth)

10824 THE MULTIPLE MESON PRODUCTION BY NUCLEAR COLLISIONS WITH HIGH ENERGY. L. von Lindern. Thesis, Munich, Universität, 1961. 150p. $2.00(Gmelin, AED-DISS. 61-356).

Properties of multiple particle production in hard jets of cosmic radiation with energies higher than 10^{10} ev are studied. Because the energies cannot be measured directly, as much information as possible must be obtained from the angular distributions. Methods for analysis are tested.

Models for multiple particle production, one-center model, Heisenberg model, and statistical model, are discussed. (Gmelin Inst.)

Criticality Studies

Refer also to abstract 10302.

10825 THE PHYSICAL THEORY OF NEUTRON NOISE IN REACTORS AND REACTOR-LIKE SYSTEMS. R. K. Osborn (Univ. of Michigan, Ann Arbor) and S. Yip. 15p. (CONF-332-9)

From Symposium on Noise Analysis in Nuclear Systems, Gainesville, Fla., Nov. 1963.

An attempt is made to unify two approaches to theoretical studies of neutron noise (multiplet densities) in reactors. The point at which this unity is achieved is the Schroedinger equation or, equivalently, the quantum Liouville equation appropriately formulated to describe the system of interest. (C.E.S.)

Direct Energy Conversion

Refer also to abstract 11477.

10826 (AD-402815) THE DEVELOPMENT OF A THERMIONIC CONVERTER MODULE SUITABLE FOR LIQUID METAL HEATING. Fifth Quarterly Technical Report, December 15, 1962 to April 1, 1963. W. B. Hall and J. J. O'Grady (Radio Corp. of America. Electron Contract AF33(657)-8005. 29p.

Development continued of thermionic energy converters for space applications. Work continued on optimization of geometry and ceramic insulation between emitters and the heat source. This work will include the development of a thermionic generator module to develop 3.0 v of potential from a liquid metal heat source. A converter, Type A-1198B, achieved output power in excess of 40 w at specified conditions. A three-converter unit was designed to investigate the processing assembly procedures and unwanted low voltage arcs before fabrication of 3-v generator begins. (auth)

10827 (AD-403362) EMITTER MATERIALS STUDY—THERMIONIC ENERGY CONVERTERS. Final Technical Report. (Ford Instrument Co., Long Island City, N. Y.). Dec. 31, 1962. Contract Nonr 3696(00). 74p.

An experimental program was conducted on selected emitter materials to determine their potential for use in low-temperature thermionic energy converters. One oxide emitter and four different dispenser types were evaluated in parallel plate and cylindrical geometry in both glass and metal ceramic construction. With respect to power density the various dispenser emitter types showed suitable and reasonably similar performance. Performance degradation was reversed in some of these diodes and its mechanism explored and explained. (auth)

10828 (AD-404118) THERMIONIC ENERGY CONVERTERS. Bibliography for 1956–1 May 1963. Randall G. Rice, comp. (Defense Documentation Center, Arlington, Va.). 39p.

A total of 79 references is given in abstracted form. (D.L.C.)

10829 (AD-405829) SUPERCONDUCTING MAGNET RESEARCH AND APPLICATION TO MHD POWER GENERATORS. Interim Scientific Report No. 1, February 1, 1963 to April 30, 1963. (Westinghouse Electric Corp. Astronuclear Lab., Pittsburgh). May 10, 1963. Contract AF33(657)-10567. 45p.

Models of a MHD generator, a superconducting magnet, and cooling equipment are analyzed to estimate the magnetic field requirements and to study superconducting magnet design for fulfilling the requirements. The total power system, including a reactor heat source and radiator, is optimized on a power to weight basis to find the optimum magnetic field. Conventional and superconducting magnets are compared to illustrate their relative merits. (D.C.W.)

10830 (AD-426096) THE DEVELOPMENT OF A THERMIONIC CONVERTER MODULE SUITABLE FOR LIQUID METAL HEATING. Eighth Quarterly Technical Report. G. Y. Eastman and J. J. O'Grady (Radio Corp. of America. Special Electronic Components Div., Lancaster, Penna.). Jan. 1964. Contract AF33(657)-8005. 28p.

Basic module design and fabrication problems were solved by the assembly and successful testing of a 3-converter module. Operation of this module proved the principle of enclosing several series-connected converters within a single vacuum envelope. The modular approach was further demonstrated by the fabrication and testing of a 3-volt (10-converter) module. As a result of extensive bonding studies, the use of expanding steel plugs to force the center tubing into a tight bond with the emitter was selected. Life testing of one Type A-1198B converter was concluded after 2403.5 hours. Another converter has completed more than 100 hours of a life test. (auth)

10831 (AI-9362) CLAD CARBIDE NUCLEAR FUEL THERMIONIC POWER MODULES. Quarterly Report No. 3. C. K. Smith (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1963. Contract AF33(657)-10876. 22p.

A rhenium-clad carbide emitter, thermionic power module, which simulates nuclear reactor installation, design, and performance is evaluated. The module is an assembly of two series-connected converters with a single common cesium reservoir. The program goal is 500 hr cumulative operation at a power density of 7 watts/cm^2 and an efficiency of 12%. Progress made includes: completion of fabrication of all clad fuel structures, completion of heat treatments and subsequent initiation of metallurgical evaluations of clad fuel specimens, completion of fabrication of all module components, and assembly of the module. A rigorous leak-check revealed the presence of a very slight leak in one end of the collector insulator tube. The module is being reassembled with a new insulator. (auth)

10832 (ASD-TDR-62-1082) HEAT DIODE CONVERTER. Milton Gottlieb, R. J. Zollweg, L. S. Richardson, A. E. Fein, and J. G. DeSteese (Westinghouse Electric Corp. Research Labs., Pittsburgh). Jan. 30, 1963. Contract AF33(616)-8262. 301p. (AD-408778)

Experimental and theoretical investigations were made on several aspects of the cesium plasma thermionic converter. Data were taken on the electron emission properties of tungsten, tantalum, molybdenum, niobium, rhenium, iridium, and tantalum carbide. Two methods were used in this study; one was the measurement of the I-V characteristics of diodes using emitters of these materials and the other was the direct measurement of the saturation emission current density by the plasma-anode technique. It is possible to make some separation between emission effects and transport effects by combining results of these two measurements. Studies were made on several important loss mechanisms in the thermionic converter. Among these were the thermal conduction loss in the cesium vapor,

losses associated with electron scattering in the plasma, and losses due to reflection of electrons by the collector. A study was also made of the evaporative loss of the emitter in the presence of cesium. The experimental data collected has been used for an extensive theoretical analysis of the efficiency and lifetime of a thermionic converter. Theoretical treatments are also given for energy and mass transfer in the cesium plasma and of electron emission in the presence of a plasma. (auth)

10833 THE ROLE OF ADSORPTION ENERGY IN THE IONIZATION OF ATOMS ON A METAL SURFACE. E. F. Chaikovskii and G. M. Pyatigorskii (All-Union Inst. for the Study of Monocrystals, Scintillating Materials, and Ultrapure Chemicals, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 153: 401-4(Nov. 11, 1963). (In Russian)

The potassium ion current I (atoms/cm^2) emitted from the (001) crystal face of a tungsten thermionic emitter was measured as a function of the emitter threshold temperature over a range of 1250 to 1500°K. The rolling process used to make the tungsten ribbon 0.2 mm thick had oriented the crystals. A 0.2 mm thick tantalum ribbon served as the collector. The results could be expressed by the equation $T = 13{,}600/(8 - \log I)$. A theory relating T and I with an adsorption energy λ, the ionization coefficient for the bare metal, and the fractional coverage θ is derived for small θ by postulating that the adsorbed atoms sit a distance δ from the reflecting surface of the metal with an effective charge e' (which are determined from electrostatic considerations). The adsorption energy is found by summing over the quadrupoles formed by the adsorbed ions. For potassium adsorbed on tungsten, $\lambda = 2.2$ ev. If it is assumed that the heat of evaporation for potassium is 0.88 ev, the evaporator temperature T_{evap} is related to the threshold temperature of the emitter T as follows: $T = 3.3\ T_{evap}$. (TTT)

10834 ELECTRON REFLECTION FROM CESIUM-COATED POLYCRYSTALLINE METALS AT LOW PRIMARY ENERGY. R. J. Zollweg (Westinghouse Electric Corp., Pittsburgh). J. Appl. Phys., 34: 2590-8(Sept. 1963).

The reflection of low-energy electrons from polycrystalline metal surfaces partially coated with cesium was investigated by the retarding potential difference technique. The technique is described, and results for primary energies below 5 ev are given. Retarding potential measurements of the longitudinal component of the reflected electron energy are consistent with elastic reflection and a cosine angular distribution at low primary energy. (auth)

10835 THERMIONIC EMISSION FROM AN EXPONENTIAL PATCH DISTRIBUTION. Robert E. Stickney (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys., 34: 3145-6(Oct. 1963).

The validity of Rasor's model, a surface model having a quasi-exponential distribution of patches (work function), for explaining the nonideal current-voltage characteristics of cesium thermionic converters under certain operating conditions, is investigated. (C.E.S.)

10836 PLASMA DIODE APPLICATIONS TO CONVERSION TECHNIQUES. E. Dieulesaint and Ph. Defranould (Compagnie Francaise Thomson-Houston, Bagneux, France). J. Phys., 24: Suppl. to No. 10, 173A-82A(Oct. 1963). (In French)

After a review of the fundamentals of the plasma diode, some designs are described. Energy conversion by plasma diodes is discussed. Applications in nuclear energy or in power generation for space crafts are described. (auth)

10837 MHD POWER GENERATION. S. Way (Westinghouse Research Labs., Pittsburgh). 40p. (CONF-284-8)

From National Electronics Conference on Adaptive Processes, Chicago, Oct. 1963.

The superposed MHD generator on a conventional steam or gas turbine plant gives a significant gain in system efficiency. The procedure for analysis of the thermodynamic processes for the combined plant is discussed. This is followed by a discussion of the flow and power generation process within the generator duct. Conductivities of the order of 5 mhos/m are seen to be required if ducts of reasonable length are to be obtained. The properties of seeded combustion products for several fuels are examined. Dry K_2CO_3 is shown to be superior to a K_2CO_3 solution for seeding, and the extent to which cesium surpasses potassium is indicated. Natural gas as fuel tends to be inferior to coal from the standpoint of product gas conductivity, but other advantages of natural gas may lead it to be a favored fuel. An example is presented of an MHD-steam 600-Mw combined plant. This example was used in conjunction with a feasibility study, which showed an attractive comparison of the MHD plant with the conventional plant. Problems for further investigation include plasma studies, duct and material studies, magnet development, coal combustion investigation, high temperature preheater development, and fouling and corrosion studies. (auth)

10838 MAGNETOHYDRODYNAMIC GENERATOR. E. T. Bezrukov. Russian Patent 155,250. 1963.

A magnetohydrodynamic generator is described in which gas is heated by an atomic reactor, passes through the MHD to a condenser, and is returned to the reactor, thus forming a closed heat-transfer cycle. (Byull. Izobret. i Tovarnykh Znakov, No. 12, 1963)

Elementary Particles and Radiations

Refer also to abstracts 10423, 10681, 11021, and 11244.

10839 (ANL-6797(p.15-20)) THE NEUTRON-ELECTRON INTERACTION. V. E. Krohn (Argonne National Lab., Ill.).

Measurements associated with electron–neutron interactions at low energies are discussed. The connection with the theory of nuclear structure and with the high-energy electron-scattering experiments that investigate nucleon structure is discussed. (R.E.U.)

10840 (ARL-63-76) THEORETICAL INVESTIGATIONS IN SOLID STATE PHYSICS USING DISPERSION RELATION TECHNIQUES. Peter Kraus and C. J. Pearson (University of Southern California, Los Angeles). May 1963. Contract AF33(616)-7781. 39p. (AD-407352)

Some properties of Jost functions are reviewed for real and complex angular momentum and compared to the determinantal expansion. The exact phase shifts and Jost functions in the complex k-plane are calculated for s- and p-waves and compared to the first and second order determinantal expansion. (auth)

10841 (AROD-2813.4) THEORY OF THE MANY-BODY BOSE SYSTEM. Final Report, June 16, 1959–June 30, 1963. P. R. Zilsel (Western Reserve Univ., Cleveland). Jan. 15, 1964. Contract DA-33-019-ORD-3003. 11p.

The collective elementary excitations and ground state properties of nonrelativistic many-body systems of bosons interacting with short-range forces were studied. Field theoretic representations initially including collective many-body effects of the strong short-range interaction were used. The treatment of superfluid helium was emphasized. The velocity constraint introduced by Lin into the Eckart variational-principle derivation of the two-fluid hydrodynamics of He II was investigated, as well as its effects. (D.C.W.)

10842 (BNL-787) NEUTRINO PHYSICS. Leon M. Lederman (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). Jan. 9, 1963. Contract AT-30-2-GEN-16. 21p.

Brookhaven Lecture Series No. 23.

The prediction and verification of the neutrino are reviewed, together with the V-A theory for its interactions (particularly the difficulties with the apparent existence of two neutrinos and the high-energy cross section). The Brookhaven experiment confirming the existence of two neutrinos and the cross section increase with momentum is then described, and future neutrino experiments are considered. (D.C.W.)

10843 (CONF-122-22) HIGH ENERGY ELASTIC SCATTERING OF $\pi^{\pm}$, p, $\bar{p}$ AND $K^{\pm}$ BY PROTONS (AND REGGE POLE PREDICTIONS). S. J. Lindenbaum (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT (30-2)-Gen-16]. 50p.

From International Conference on Nucleon Structure, Stanford, Calif., June 1963.

The counter hodoscope experiments at incident particle momenta of 7-20 Bev/c are summarized. The data are presented, together with the associated Regge pole analyses. The effective radii, opacities, and total cross sections obtained for the interactions are included. A magnetic spectrometer setup used for low four-momentum transfer data is also described, and optical theorem predictions for π^--p and p-p are given. (D.C.W.)

10844 (INSJ-64) ELECTRONIC CIRCUITS FOR THE MEASUREMENT OF SPIN CORRELATION COEFFICIENTS IN PROTON-PROTON SCATTERING AT 52 Mev. Izuo Hayashi, Hiromi Hasai and Keigo Nisimura (Tokyo Univ. Inst. for Nuclear Study). Dec. 13, 1963. 17p.

Circuitry used in an experiment to measure the spin correlation coefficients is described. Adjustments to the circuits are discussed, as well as the reliability of the circuitry. (D.C.W.)

10845 (JINR-P-1454) K OTSENKE MASSY MYUONNOGO NEITRINO. (On the Upper Limit of the Muon Neutrino Mass). O. A. Zaimidoroga, M. M. Kulyukin, R. M. Sulyaev, I. V. Falomkin, A. I. Filippov, V. M. Tsupko-Sitnikov, and Yu. A. Shcherbakov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1963. 9p.

The range-energy relation for 0.2 to 3.0 Mev tritons moving through helium was obtained experimentally and was used to evaluate the mass of the neutrino in the interaction $\mu^- + He^3 \rightarrow H^3 + \nu$ as 6 Mev/c^2. (D.C.W.)

10846 (JINR-P-1458) ANALIZ IMPUL'SNOGO SPEKTRA PROTONOV OTDACHI V NEUPRUGIHK π^--p VZAIMODEISTVIYAKH PRI 7 Gev. (An Analysis of the Recoil Proton Momentum Spectrum in Inelastic π^-p Interactions at 7 Bev). V. S. Barashenkov, D. I. Blokhintsev, I. Patera, and L. G. Semashko (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 8p.

The recoil proton spectra calculated by the one-meson theory are compared with experimental data. Agreement may be obtained if resonance interactions at 2.5 to 3 Bev are assumed. (auth)

10847 (JINR-P-1461) KRITERII TRAIMANA-YANGA DLYA ROAKTSII $n + p \rightarrow p + p + \pi^-$. (Traiman-Yang Criterion for the Reaction $n + p \rightarrow p + p + \pi^-$). Tzy-tzan Huang (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 6p.

The application of Traiman-Yang criterion to the interaction $n + p \rightarrow p + p + \pi^-$ is considered. An experimental check on this criterion is suggested. (auth)

10848 (JINR-P-1462) ISSLEDOVANIE K^+-p-VZAIMODEISTVIYA PRI BOL'SHIKH ENERGIYAKH S POMOSHCH'YU STATISTICHESKOI TEORII MNOZHESTRESTVENNOGO ROZHDENIYA CHASTITS. (Investigation of K^+p Interaction at High Energies by Statistical Theory of Multiple Particle Production). I. N. Kukhtina and R. Ronchka (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 8p.

The interaction K^+-p was investigated at 1.3 and 5 Bev. Taking into account the two- and three-particle resonances the spectra of different particles were obtained, as well as the average values for the number of different particles as a function of energy. (auth)

10849 (JINR-P-1467) O VOZMOZHNYKH REZONANSAKH V RASPADAKH K-MEZONOV. (On Possible Resonances in K-Meson Decays). V. L. Lyuboshits and E. O. Okonov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1963. 9p.

A possible effect of the two-pion resonances with mass less than 500 Mev on the leptonic and radiative decays of mesons (K) is discussed. It is shown that the existence of such resonances in the 400-Mev region does not contradict the experimental evidence on meson (K) decays. (auth)

10850 (JINR-P-1469) ASIMMETRIYA VYLETA BARIONOV, POSTOYANSTVO POPERECHNOGO IMPUL'SA I PRINTSIP NEOPREDELENNOSTI. (Asymmetry in Baryon Emission, Constancy of the Transverse Momentum and Uncertainty Principle). K. D. Tolstov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1963. 11p.

The energy independence of the nucleon transverse momentum in elastic collisions of fast particles is attributed to the constancy of the interaction region on the basis of the uncertainty principle. The preferential emission of baryons in π-N interactions in the direction of their initial motion in the center-of-mass system may be accounted for on the basis of the magnitude of their total momentum and, according to the uncertainty principle and relativity, the interaction region in the longitudinal and transverse directions. (auth)

10851 (JINR-P-1474) DVOINAYA PEREZARYADKA π^+-MEZONOV. (Double Charge Exchange of π^+ Mesons). Yu. A. Batusov, S. A. Bunyatov, V. M. Sidorov, and V. A. Yarba (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1963. 3p.

The double charge exchange of mesons(Ti^+) was detected on emulsion nuclei. The value of the cross section for the process was found to be $(5 \pm 1)\ 10^{-28}$ cm^2 at energies of 30 to 80 Mev. (auth)

10852 (JINR-P-1484) OPTICHESKAYA TEOREMA DLYA RASSEYANIYA CHASTITS S PROIZVOL'NYMI SPINAMI. (Optical Theorem for the Scattering of Particles with Arbitrary Spins). P. Winternitz (Vinternitts) (Joint

Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 7p.

An expression is obtained for the imaginary part of the zero-angle scattering matrix for polarized particles of arbitrary spins. The types of initial polarization that can influence the total cross section are discussed. Nucleon-deuteron scattering is considered as an illustration of the general results. (auth)

10853 (LNF-62/114) DISTRIBUZIONE ANGOLARE DELLA BREMSSTRAHLUNG IN CRISTALLI SOTTILI. Nota interna: n. 179. (Angular Distribution of Thin Crystal Bremsstrahlung. Note No. 179). G. Barbiellini, G. Bologna, G. Diambrini, and G. P. Murtas (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Dec. 22, 1962. 27p.

The coherent part of the differential cross section for the production of linearly polarized photons (bremsstrahlung) in crystals is calculated. The differential cross section is integrated over the emission angles to obtain the photon energy spectrum and its polarization. (D.C.W.)

10854 (LNF-63/47(p.1-35)) RELAZIONE RIASSUNTIVA DEI RECENTI RISULTATI SPERIMENTALI OTTENUTI CON L'ELETTROSINCROTRONE DI FRASCATI. (Report Summarizing Recent Experimental Results Obtained with the Frascati Electrosynchrotron). P. Argan and G. Diambrini-Palazzi.

An attempt is made to present a panoramic view of the laboratory experiments carried out with the Frascati electrosynchrotron. In the study of new resonances two experiments were carried out: photoproduction of the η particle and study of its decay and photoproduction of the ABC particle. In the area of electrodynamics, the photoproduction of μ pairs and the annihilation in flight of 800-Mev positrons were studied. The results of experiments on coherent bremsstrahlung were also included. Studies on the photoproduction of neutral and singly charged pions on hydrogen, of K mesons on hydrogen, of π^0 in the Coulomb field of the nucleus, and of singly and multiply charged pions on complex nuclei are described. In conclusion, the absorption of π^- on copper, lead, and tin is considered. The experimental apparatus used and the results obtained in all the studies are discussed. (J.S.R.)

10855 (LNF-63/47(p.50-4)) 4. FOTOPRODUZIONE DOPPIA DI MESONI π CARICHI SU PROTONE. (IV. Double Photoproduction of Charged π Mesons on Protons). G. Corteliessa (Italy. Istituto Superiore di Sanità, Rome).

The theoretical regions that suggest the study of the double photoproduction of charged π mesons on protons are briefly indicated. The possibility of obtaining primary data using a cloud chamber is discussed. Extension of such measurements with a device that would permit collection of the data with better statistical precision is considered. The measurement of the photoproduction of both "mixed" and neutral meson pairs and the importance of such measurements are emphasized. (J.S.R.)

10856 (LNF-63/47(p.54-8)) FUTURI SVULUPPI DELLE MISURE DI FOTOPRODUZIONE DI π^0 IN IDROGENO E IN PIOMBO (EFFETTO PRIMAKOFF). (Future Development of the Measurement of the Photoproduction of π^0 in Hydrogen and in Lead (Primakoff Effect)). G. Bellettini, C. Bemporad, P. L. Braccini (Italy. Istituto Nazionale di Fisica Nucleare, Pisa and Pisa, Italy. Università. Istituto di Fisica); L. Foà (Italy. Istituto Nazionale di Fisica Nucleare, Florence); and E. H. Bellamy (Westfield Coll., London).

An analysis of the data available up to the present time on the Primakoff effect is made. The experimental points are compared with the cross sections from the coherent superposition of electromagnetic processes and of nuclear production. The differential cross section for the photoproduction of π^0 in H_2 in the center-of-mass system was determined and corrected for "ghost" protons. The present experimental results are compared with those obtained previously. (J.S.R.)

10857 (LNF-63/47(p.58-61)) PROGETTO DI MISURA DELLA SEZIONE D'URTO ANGOLARE NELLA FOTOPRODUZIONE SINGOLA DI π^0 ED η^0 SU PROTONI E NEUTRONI PER ENERGIA ATTORNO AL Gev. (Project for the Measurement of the Angular Cross Section in the Single Photoproduction of π^0 and η^0 on Protons and Neutrons for Energies Around a Bev). G. Bellettini, C. Bemporad, P. L. Braccini (Italy. Istituto Nazionale di Fisica Nucleare, Pisa and Pisa, Italy. Università. Istituto di Fisica); and L. Foà (Italy. Istituto Nazionale di Fisica Nucleare, Florence).

An experiment for the measurement of the angular distribution with good statistics (typically ±5%) and with good energy resolution is proposed for angles from 0 to 30°. The experimental set-up (shown graphically) consists of two Cherenkov counters that can detect the γ from π^0 when the decay plane is vertical. The second purpose of the experimental arrangement is the measurement of the differential cross section for the reaction $\gamma + p \rightarrow \pi^0 + p$ at the maximum energies obtainable with the Frascati electrosynchrotron. Experimental curves obtained at 1140 Mev are shown to indicate the errors expected from studies at 1050 Mev. Other studies possible using this experimental setup are indicated. (J.S.R.)

10858 (LNF-63/47(p.62-4)) STATISTICAL ANALYSIS OF RECENT RESULTS ON TOTAL CROSS-SECTION FOR POSITRON-ELECTRON ANNIHILATION. G. Torelli (Italy. Istituto Nazionale di Fisica Nucleare, Pisa).

Measurements of the total cross section for positron-electron annihilation in flight have been made to test the validity of the radiative correction and to look for a breakdown of quantum electrodynamics at high momentum transfers. To compare the experimental results with the theoretical corrections to the Dirac first approximation formula, $\Delta = (\sigma_{exp}/\sigma_D) - 1$ is plotted for the experimental values reported in the literature. A χ^2 test is made using all the experimental points or the subset of the consistent measurements only. The confidence levels are tabulated. The results obtained do not suggest the existence of a breakdown of quantum electrodynamics, and the radiative corrections are excluded with 95% confidence. A fifty-fifty confidence level for the radiative corrections can be obtained by assuming that all measurements are affected by a systematic error of −2%. (J.S.R.)

10859 (LNF-63/47(p.64-7)) MISURE DELLA SEZIONE D'URTO DIFFERENZIALE DI ANNICHILAZIONE $e^+ + e^- \rightarrow 2\gamma$. (Measurement of the Differential Cross Section for the Annihilation $e^+ + e^- \rightarrow 2\gamma$). G. Torelli (Pisa, Italy. Università. Istituto di Fisica and Italy. Istituto Nazionale di Fisica Nucleare, Pisa).

An experimental arrangement for measurement of the differential cross section for the annihilation $e^+ + e^- \rightarrow 2\gamma$ is sketched and discussed. The angle of emission of the two annihilation γ rays is measured as a function of the production angle at the baricenter. Measurements can be made from 90 to 5°. The cross sections and the counting frequency are given for an incident positron energy of 800 Mev with a Be target of 1 g/cm^2. (J.S.R.)

10860 (LNF-63/47(p.68-71)) MISURA DELLA SEZIONE D'URTO DI SCATTERING DI ELETTRONI E POSITRONI SU ELETTRONI. (Measurement of the Scattering Cross Section of Electrons and Positrons on Electrons). G. Torelli (Pisa, Italy. Università. Istituto di Fisica and Italy. Istituto Nazionale di Fisica Nucleare, Pisa).

An experimental set-up to measure with good precision the radiative correlation for Moeller scattering and the corrections to the Bhabha scattering is sketched and described. A block diagram of the electronic device for the measurement is given. The possible errors occurring in the measurement are discussed. The device can be used to measure symmetrically Bhabha and Moeller scattering and to compare these two cross sections without experimental bias. (J.S.R.)

10861 (LNF-63/47(p.71-2)) PROGRAMMA DI MISURA NELLA REAZIONE $\gamma + p \rightarrow \eta + p$ DA PARTE DEL GRUPPO FRASCATI η. (Program for Measurements on the Reaction $\gamma + p \rightarrow \eta + p$ by the Frascati η Group). C. Bacci, C. Mencuccini, G. Penso, G. Salvini, V. Silvestrini, and A. Wattenberg.

The data determined previously by the Frascati group on the photoproduction of η and its quantum numbers, mass, decay, and production relative to pions are briefly summarized. The primary objective of future studies on this reaction will be a measurement of $d\sigma/d\theta$ at various energies and at $\theta^* \sim 20°$. The theoretical interest of such measurements is briefly indicated. (J.S.R.)

10862 (LNF-63/47(p.73-4)) FOTOPRODUZIONE DI π^- IN IDROGENO. (Photoproduction of π^- in Hydrogen). M. Beneventano, R. Finzi, L. Paoluzi, F. Sebastiani, M. Severi, and F. Villa.

An experimental study of the reaction $\gamma + p \rightarrow (p + \pi^+) + \pi^-$, where $(p + \pi^+)$ has the energy of the primary resonance, was proposed. The purpose was to determine the mass spectrum of the $(p + \pi^+)$ system (at photon energies corresponding to the second resonance at fixed angles for the emission of π^-) in order to place the peak of the first resonance and to evaluate the contribution of $p + \pi^+$ unbound in the isobar to the reaction. A second aim was to vary the energies in such a manner that the $(p + \pi^+)$ system covers the first resonance. The third part of the program was to determine the angular distribution of π^- if the $p + \pi^+$ background is negligible. The procedure and experimental set-up to be used in the study are described, and the counting intensity to be expected is estimated. (J.S.R.)

10863 (LNF-63/47(p.75-82)) INTERESSE TEORICO DELLA FOTOPRODUZIONE E DELL'EFFETTO COMPTON DA γ POLARIZZATI. (Theoretical Interest in Photoproduction and the Compton Effect by Polarized γ). A. Contogouris, B. De Tollis, and A. Verganelakis.

The effects of the use of polarized γ rays in photoproduction of π^0 on the analysis of the pion-pion interaction were theoretically considered. The contribution of the effects of polarized γ rays to the discrepancy in the theoretical and experimental measurement of the Compton effect was also considered. (J.S.R.)

10864 (LNF-63/47(p.82-6)) USO DELLA BREMSSTRAHLUNG COERENTE NELLE REAZIONI FOTONUCLEARI. (Use of Coherent Bremsstrahlung in Photonuclear Reactions). G. Barbiellini, G. Bologna, G. Diambrini, and G. P. Murtas (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

The coherent bremsstrahlung obtained by bombarding a diamond target with 1-Bev electrons is to be used to study the reaction $\gamma + p \rightarrow \pi^0 + p$. The bremsstrahlung spectrum and its polarization were reported for 1-Bev electrons in a diamond crystal at room temperature as a function of the fractionated energy of photons $x = k/E_1$ for an angle of 20 mrad between the electron direction and the [110] axis. Preliminary measurements have consisted in the determination of a number of photoproduced π^0 mesons as a function of the angle between incident electrons and [110] axis. The results are reported graphically. (J.S.R.)

10865 (LNF-63/47(p.86-9)) PROGRAMMA PRELIMINARE DI RICERCA CON γ POLARIZZATI NELLA FOTOPRODUZIONE DI π^+ (200–400 Mev). (Preliminary Research Program with Polarized γ in the Photoproduction of π^+ (200–400 Mev). M. Grilli, L. Mezzetti, M. Nigro, and E. Schiavuta.

A study on the photoproduction of charged π at low energies (200 to 400 Mev) by the process $\gamma + N = \pi^+ + N$ (N = nucleon) was undertaken to determine the type and degree of information that could be obtained by the use of polarized photons. The experimental problems peculiar to experiments of this type are examined, and some preliminary measurements on the production of π^+ are shown graphically. (J.S.R.)

10866 (LNF-63/47(p.94-7)) PROTON COMPTON EFFECT AND THE η LIFETIME. R. Del Fabbro, M. de Pretis, E. Ganssauge, R. Gomez, R. Jones, G. Stoppini, and L. Tau.

The Gell-Mann method was used to calculate the lifetime of the η meson, and the value obtained was $T = 10^{-1}$. Two indirect measurements suggested for the measurement of this lifetime are described, and one, the observation of the contribution of the Low diagram to the Compton proton effect, was theoretically calculated. The results of the calculation are shown for a lifetime of 10^{-20} sec. Four experimental configurations for determination of the Compton cross section were studied in detail. One configuration, centered around 90° center of mass, is sketched, and the counting rate obtainable is determined. (J.S.R.)

10867 (LNF-63/47(p.98-104)) SPETTRO DI MASSA DEL SISTEMA PIONE-PIONE NELLA FOTOPRODUZIONE DOPPIA IN IDROGENO. (Mass Spectrum of the Pion-Pion System in Double Photoproduction in Hydrogen). R. Del Fabbro, M. De Pretis, R. Jones, G. Marini, A. Odian, G. Stoppini, L. Tau, and R. Visentin.

The reaction $\gamma + p \rightarrow p + \pi^+ + \pi^-$ was studied near the threshold for two-pion production in hydrogen. The purpose of the study is to show a π-π interaction that was indicated by Abashian, Booth, and Crowe. The experimental configuration used to measure the proton angles in a scintillation chamber is described. The statistical procedure used to determine the mass spectrum of the system is outlined in some detail. The difficulties of the method are also shown. The improved experimental device resulting from an analysis of the difficulties of the original method is described and discussed. (J.S.R.)

10868 (LNF-63/47(p.105-8)) POSSIBILE DETERMINAZIONE DEL FATTORE DI FORMA ELETTROMAGNETICO DEL π^+ DAL PROCESSO DI ELETTROPRODUZIONE. (Possible Determination of the Electromagnetic Form Factor of π^+ from Electroproduction Processes). E. Amaldi, G. V. DiGiorgio, G. Marini, G. Stoppini, and M. Vincelli.

Preliminary theoretical considerations of the determination of the electromagnetic form factor of π^+ from the re-

action $e^- + p \rightarrow \pi^+ + n + e^-$ are given. The correspondence between photoproduction and electroproduction is discussed. The possibility of experimentally isolating the contribution of the direct interaction term is considered. (J.S.R.)

10869 (LNF-63/47(p.109-12)) PROGRAMMA DI RICERCA DEL GRUPPO PADOVA. (Research Program of the Padova Group). M. Grilli, P. Joos, L. Mezzetti, M. Nigro, E. Schiavuta, and F. Villa.

The results obtained in the study at Padova of the reaction $\gamma + p \rightarrow K^+ + \Lambda^0$ are briefly described in order to present and discuss the development of this measurement within the framework of the present theoretical and experimental situation on the production of K from γ and π. (J.S.R.)

10870 (LNF-63/47(p.112-14)) PROPOSTA DI ESPERIENZA PER LA MISURA DELLA VITA MEDIA DEL MESONE η^0 TRAMITE L'EFFETTO PRIMAKOFF. (Proposal for the Experimental Measurement of the Mean Life of the η^0 Meson Using the Primakoff Effect). G. Bellettini, C. Bemporad, P. L. Braccini (Italy. Istituto Nazionale di Fisica Nucleare, Pisa); L. Foà (Italy. Istituto Nazionale di Fisica Nucleare, Florence); and M. Toller (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

The formulas for the cross section of η^0 by the Coulomb process γ + nucleus $\rightarrow \eta^0$ + nucleus in hydrogen and heavy nuclei with zero spin, in which a virtual γ is given by the Coulomb field of the target nucleus and a real γ is furnished by an electrosynchrotron, are given. The experimental parameters that can be deduced from an examination of these formulas are briefly indicated. (J.S.R.)

10871 (LNF-63/47(p.118-21)) REGGE POLES AND PERTURBATIVE EXPANSION IN Q.E.D. G. Bisiacchi, A. Nocentini, and T. Weber (Trieste. Università. Istituto di Fisica and Italy. Istituto Nazionale di Fisica Nucleare, Trieste).

The high-energy behavior of cross sections of Coulomb scattering, $e^- - e^-$ scattering, and electron–photon scattering was studied to find evidence of Regge behavior in inelastic processes. No evidence of Regge behavior was found in the Compton effect. (J.S.R.)

10872 (LNF-63/47(p.169-74)) REPORT ON THE EXPERIMENTS DONE AT ORSAY ON LOW AND MEDIUM ENERGY PHYSICS WITH THE LINEAR ACCELERATOR. G. R. Bishop (Paris. Université, Orsay. École Normale Supérieure. Laboratoire de l'Accélérateur Linéaire).

The standard apparatus used for the study of the elastic and inelastic scattering of electrons from 40 to 500 Mev consists of current monitors for the incident beam, a magnetic spectrometer of high-energy dissipation, and a Cherenkov detector for the electrons analyzed. A schematic diagram of the apparatus is given, and the technique used is discussed. Analysis of the cross sections for elastic and inelastic scattering is illustrated. Attempts to interpret the quasi-elastic continuum either by direct calculation or by the application of sum rules are indicated. (J.S.R.)

10873 (LNF-63/47(p.213-18)) COMPARISON OF POSITRON AND ELECTRON SCATTERING. W. C. Barber (Stanford Univ., Calif. High-Energy Physics Lab.).

Some experiments that can be performed with a 400- to 500-Mev positron beam are briefly discussed. A recent experiment indicated that at high values of q ($q^2 = 20\ f^{-2}$) the cross section for positron scattering from the proton is considerably larger than that for electron scattering from the proton. Experimental verification of this will require the comparison of the scattering of positrons and electrons from a number of light nuclei in order to establish the domain of validity of the Born approximation. As examples of the type of experiment that can be done with the Frascati positron beam, the elastic scattering of positrons and electrons from C^{12}, study of nuclear charge distributions by the e^+/e^- comparison method, and inelastic scattering with excitation of nuclear states are discussed. (J.S.R.)

10874 (NP-13571(p.1-5)) A CONSTRUCTION OF THE REPRESENTATIONS OF SU(3). A. H. Aitken (Naval Research Lab., Washington, D. C.).

The irreducible representations of SU(3) are derived by methods used for SU(2). The states of a given representation can be written down in a simple manner and are expressed directly as eigenfunctions of the operators of interest (I-spin and hypercharge). (D.C.W.)

10875 (NP-13571(p.6-12)) REPRESENTATIONS OF SU(3). D. W. Joseph (Naval Research Lab., Washington, D. C.).

The structure of irreducible representations of SU(3) is determined by a specialization of methods used in the general study of semi-simple Lie groups. (D.C.W.)

10876 (NYO-10565) THE SELF-CONSISTENCY APPROACH TO PARTICLE SYMMETRIES. R. E. Cutkosky (Carnegie Inst. of Tech., Pittsburgh). Dec. 1963. Contract AT(30-1)-882. 10p.

The origin of the higher symmetries among strongly interacting particles is examined. The possibility that crossing symmetry necessarily forces the existence of particle symmetries is particularly considered. Support for a dynamical origin of symmetries is noted. (D.C.W.)

10877 (PPAD-506D) RELATIVISTIC TRANSFORMATIONS OF PARTICLE POLARIZATIONS. G. R. Henry, G. Schrank (Princeton Univ., N. J. Palmer Physical Lab.); and R. A. Swanson (California. Univ., La Jolla). Nov. 22, 1963. Contract AT(30-1)-2137. 16p.

Transformations of particle polarizations between the laboratory and center-of-mass reference frames are derived. The muon from kaon decay ($\mu 2$) in flight is used to illustrate the difference in polarization transformation under the Galilean and Lorentz transformations. The kaon decay ($\mu 2$) at a kaon momentum of 0.7 Bev/c and the Thomas precession for a spinning particle are considered as examples of polarization transformation. (D.C.W.)

10878 (SLAC-25(Pt.I)(p.19-29)) A CHARGE AND ISOTOPIC SPIN ANALYSIS ON THE WEAK INTERACTIONS. G. Feldman (Johns Hopkins Univ., Baltimore).

The weak interactions are analyzed in terms of Yukawa interactions. (D.C.W.)

10879 (SLAC-25(Pt.I)(p.88-124)) CONSIDERATIONS OF THE USE OF MONOCHROMATIC PHOTON BEAMS. G. R. Bishop (Paris. Université, Orsay. École Normale Supérieure. Laboratoire de l'Accélérateur Linéaire).

Experimental situations involving inelastic photon scattering and the detection of two-body states in photoproduction are examined to illustrate two advantages of using monochromatic photon beams. The information that should be obtainable in inelastic nuclear scattering of intense muon beams is also considered in relation to the electron scattering experiments. (D.C.W.)

10880 (SLAC-25(Pt.I)(p.125-33)) ELASTIC e-p KINEMATICS FOR SLAC. C. de Vries (Amsterdam. Instituut voor Kernphysisch Onderzoek).

A program was written for the IBM 7090 to calculate the kinematics, cross sections, form factors, and counting rates in electron-proton scattering as functions of four momentum transfer and scattering angle. Some results are included. (D.C.W.)

10881 (SLAC-25(Pt.I)(p.134-48)) STATISTICAL FITS TO ELECTRON-PROTON AND ELECTRON-DEUTERON CROSS SECTIONS. C. de Vries (Amsterdam. Instituut voor Kernphysisch Onderzoek).

A theoretical model (described) was adopted for the isotopic form factor in order to derive theoretical cross sections. The cross sections were then compared point by point with experimental data sets for four momentum transfers of 25 to 45 f^{-2}. The free parameters in the model were adjusted by statistical methods. The proton form factors thereby obtained agreed well with other determinations while the neutron form factor disagreed. The form factor behavior was extrapolated up to 1000 f^{-2}. (D.C.W.)

10882 (SLAC-25(Pt.I)(p.167-86)) ELECTRON SCATTERING AT 20 Gev. Karl Berkelman (Cornell Univ., Ithaca, N. Y.).

Elastic electron-proton scattering experiments at energies up to 20 Bev are shown to be feasible. The experimental problems are discussed, and an experiment for measuring the elastic electron-proton differential cross section at 20 Bev is outlined. The feasibility of measuring the pion charge form factor by inelastic electron-meson(π) coincidence measurements is shown. Measurement of the total inelastically scattered electron energy spectrum is shown to be impossible. (D.C.W.)

10883 (SLAC-25(Pt.I)(p.187-94)) ELASTIC ELECTRON-PROTON SCATTERING CHOICE OF ANGLES AND ENERGIES. R. Wilson (Cambridge Electron Accelerator, Mass.).

Possible deviations from the first Born approximation in high-energy electron-proton scattering are considered, together with promising angles for these experiments. Other experimental aspects, particularly the choice of a detection method, are also considered. It is concluded that a 6-Bev/c, 5-msr solid angle, 0.1%-resolution spectrometer should be designed. A 15-Bev/c spectrometer with 2% resolution is concluded to be useful for coincidence experiments only. (D.C.W.)

10884 (SLAC-25(Pt.I)(p.195-9)) PHOTOPRODUCTION OF μ PAIRS AND e PAIRS AT SLAC. R. Wilson (Cambridge Electron Accelerator, Mass.).

It is concluded that a meson(μ) pair photoproduction experiment could be designed to test quantum electrodynamics far better than such experiments at the Cambridge Electron Accelerator. The apparatus is described, and the merits of the experiment are considered in relation to other quantum electrodynamic checks. (D.C.W.)

10885 (TID-20109) HIGH-ENERGY PROTON-PROTON SCATTERING. Robert Serber (Columbia Univ., New York). [1963]. Contract AT(30-1)-1934. 22p.

The optical model for high energy proton-proton scattering, which was previously proposed, predicts that, for large momentum transfers, the dependence of the elastic cross section on the square of the momentum transfer is approximately an inverse sixth power law. It is shown that this prediction is borne out very well by the new measurements of Cocconi for their highest proton energies (near 30 Bev). The prediction was checked down to cross sections as small as 2×10^{-12} of the forward scattering cross section and to center of mass scattering angles as large as 82°. For lower energies the measured cross sections deviate from the theoretical curve, becoming larger as the center of mass scattering angle approaches 90°. The cross section for large momentum transfers depends on the behavior of the absorptive potential near r = 0, while that for small momentum transfers depends on the behavior for large r. It is shown that a potential can be constructed to fit the observations for the entire range of momentum transfers. This potential is of Yukawa form for $r < (1/3) \times 10^{-13}$ cm, and of Gaussian form for $r > 1.1 \times 10^{-13}$ cm. The range of the Yukawa potential is determined by the width of the diffraction curve for large momentum transfer, the range of the Gaussian by the width for momentum transfer near zero. (auth)

10886 THE AMPLITUDE OF VIRTUAL COMPTON SCATTERING ON NUCLEONS. E. Kapuścik (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Polon., 24: 693-4(Nov. 1963).

It is shown that in the virtual Compton scattering on nucleons the amplitude depends on the charge, the anomalous magnetic moment, and one new constant in an approximation linear in the wave vectors of the incoming and scattered photons. (auth)

10887 INFLUENCE OF ABSORBED HYDROGEN ON THE ANGULAR DISTRIBUTION OF PHOTONS FROM TWO-QUANTUM ANNIHILATION IN TITANIUM. J. Wesolowski, B. Rozenfeld, and M. Szuszkiewicz (Boleslaw Bierut Univ., Wroclaw, Poland). Acta Phys. Polon., 24: 729-34(Dec. 1963).

The angular distribution of gamma rays from two-quantum electron-positron annihilation in titanium and in H-Ti system of 1.91 H/Ti concentration was measured. Curves illustrating the two distributions and normalized to the same height in the center were compared. The curve corresponding to the H-Ti system seems to be broader than the one obtained for pure titanium. The experimental curves were compared with theoretical Fermi momentum distributions calculated for 2, 3, 4, 5, and 6 free electrons per titanium atom. The usual assumption was made that positrons are thermalized prior to annihilation and that they annihilate only with electrons of an ideal Fermi gas. From the comparison a conclusion may be drawn that the number of free electrons per titanium atom is not less than 3 in pure titanium and about 6 in the investigated H–Ti system. The results suggest that the positive ionization of the absorbed hydrogen is almost complete. (auth)

10888 A DETERMINATION OF ZEROS ON THE PION-NUCLEON FORWARD SCATTERING AMPLITUDE. Romuald Wit (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Polon., 24: 741-7(Dec. 1963).

The scattering amplitude $T^{(1)}(\omega)$ of pions on nucleons is considered. A new method for its zeros determination is obtained. It is shown that it is impossible to fit the experimental data of Orear $T^{(1)}(1) < 0$ to the value of $T^{(1)}(0) > 0$. (auth)

10889 ANALYTICITY PROPERTIES IN ENERGY OF THE COMPLEX J PARTIAL WAVE AMPLITUDES IN THE SCATTERING OF PARTICLES WITH SPIN. Francesco Calogero (Princeton Univ., N. J.) and John M. Charap. Ann. Phys. (N. Y.), 26: 44-54(Jan. 1964).

The energy dispersion relations for the complex J partial wave amplitudes for the scattering of particles with arbitrary spin are derived. A discussion is given of the Gribov-Pomeranchuk-Azimov essential singularities, and of a mechanism that might prevent their propagation to indefinitely large values of J. Some properties of Jacobi functions are presented. (auth)

10890 ON THE BORN APPROXIMATION IN THE POTENTIAL SCATTERING OF PARTICLES WITH ARBITRARY SPINS. Francesco Calogero (Princeton Univ., N. J.) and John M. Charap. Ann. Phys. (N. Y.), 26: 55-71 (Jan. 1964).

The Born approximation to the scattering amplitude is discussed for the potential scattering problem with many channels and arbitrary spins. This is done for the full amplitude in both the representation in which magnetic quantum numbers are diagonal and in the helicity representation, and for the partial wave amplitude in the helicity representation. Spin-orbit interactions are also treated. A discussion of the asymptotic behavior for large momentum transfer is given, on the basis of which it is conjectured that for a specified class of potentials, the Regge poles will retreat to the left-hand J-plane for high energies. (auth)

10891 PIONIC RESONANCES. G. Puppi (CERN, Geneva). Ann. Rev. Nucl. Sci., 13: 287-338(1963).

The pionic resonances or bosons of strangeness zero are discussed with emphasis of η, ρ, and ω. Various modes of $\pi-\pi$ interactions are discussed. 74 references. (R.E.U.)

10892 STRANGE-PARTICLE RESONANT STATES. R. H. Dalitz (Univ. of Chicago). Ann. Rev. Nucl. Sci., 13: 339-430(1963).

Properties of strong interaction processes are discussed. The study of resonant states is reviewed; mesonic resonances, pion-hyperon resonances, pion-xi resonances, and K-N systems are discussed. 134 references. (R.E.U.)

10893 THE PHYSICS OF MUONS AND MUON NEUTRINOS. Gerald Feinberg and Leon M. Lederman (Columbia Univ., New York). Ann. Rev. Nucl. Sci., 13: 431-504(1963).

The static properties of the muon are discussed. Electromagnetic and weak interactions of muons and muon neutrinos are reviewed. Muonic atoms and molecules and possible anomalous interactions are discussed. 230 references. (R.E.U.)

10894 RADIATIVE TRANSFER IN FINITE HOMOGENEOUS ATMOSPHERES WITH ANISOTROPIC SCATTERING. I. LINEAR SINGULAR EQUATIONS. T. W. Mullikin (RAND Corp., Santa Monica, Calif.). Astrophys. J., 139: 379-96(Jan. 1, 1964).

A study is made of the scalar transport equation for homogeneous atmospheres of finite thickness with anisotropic scattering. Linear singular integral equations are derived for the source function J at symmetric depths x and τ-x. These are necessary conditions on the solution to the transport equation. Other necessary conditions are obtained by adding to the singular equations certain linear constraints. In the derivation of these equations a systematic method is given for deriving characteristic functions for any phase function; these functions were derived by Chandrasekhar only for a limited class of phase functions. The values of the function J on the boundary of the atmosphere are simply related to Chandrasekhar's ϕ_m and ϕ_m functions, which determine the scattering function S and the transmission function T. (auth)

10895 MOMENT METHOD FOR SOLUTION OF THE SCHWARZSCHILD-MILNE INTEGRAL EQUATION. Jean I. F. King and E. T. Florance (Geophysics Corp. of America, Bedford, Mass.). Astrophys. J., 139: 397-403(Jan. 1, 1964).

The underlying basis of the extreme accuracy of the double-Gauss quadrature formula devised in the method of discrete ordinates is uncovered in an alternative solution of the transfer equation. The Schwarzschild-Milne integral equation is solved by approximating the exponential integral kernel with a finite sum of exponential functions. A moment method is used to provide the best fit to the kernel. The constants that result are identical to those following from the choice of a double-Gauss quadrature formula in the discrete ordinate method. The integral equation formalism is then applied to the non-gray atmosphere problem. (auth)

10896 THE INFLUENCE OF A CHARGE ON A CHARGED PARTICLE FLUX. J. Telford (Commonwealth Scientific and Industrial Research Organization, Chippendale, New South Wales). Australian J. Phys., 16: 464-74(Dec. 1963).

The variations in intensity of a charged particle flux when observed from a position adjacent to a point charge were calculated. This was done to estimate the effect of a Coulomb field on charged particles in space. It is shown that for repulsion a region of complete shadow occurs that has a width, at a particular radius, dependent on the particle energy, the radial distance, and the magnitude of the scattering charge. (auth)

10897 THE NUMBER OF INDEPENDENT VARIABLES FOR AN n-PARTICLE COLLISION. J. Cunningham (University Coll. of North Wales, Bangor, Wales). Australian J. Phys., 16: 586-7(Dec. 1963).

A formula for the number of independent variables describing the scattering of n-particles (neutral scalar bosons) is presented. (C.E.S.)

10898 RZEWUSKI'S ISO-SPACE AS A CURVED COMPLEX SPACE. J. Mozrzymas (Inst. of Physics, Polish Academy of Sciences, Wroclaw). Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 11: 593-8(1963).

The simplest faithful representation $Z_{\alpha\dot{\beta}}$ of the complex coordinates of spinor space, which was previously used by Rzewuski as a geometrical basis for the theory of elementary particles, is investigated. It is shown that the geometry of the space $Z_{\alpha\dot{\beta}}$ may be considered as the geometry of the complex space $R_4(i)$. It is also shown that the Rzewuski iso-space can be considered as the curved complex space $S_3(i)$. (C.E.S.)

10899 THE INVERSION OF THE ANGLE OF HELICITY AS A CONFORMAL TRANSFORMATION IN MINKOWSKI'S SPACE-TIME. J. Mozrzymas (Inst. of Physics, Polish Academy of Sciences, Wroclaw). Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 11: 599-601(1963).

It is shown that inversion of the angle of helicity may be considered as a conformal transformation in Minkowski's space-time. The inversion of the angle of helicity takes place in the inversion of helicity of elementary particles. (C.E.S.)

10900 ON AN APPROXIMATE SECOND-ORDER FERMION DENSITY MATRIX. S. Pruski (Nicholas Copernicus Univ., Torun, Poland). Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 11: 615-19(1963).

The properties of an approximate second-order fermion density matrix are presented. (C.E.S.)

10901 COMPLEX SPACES AND QUATERNIONS IN LEPTON THEORY. Kuo-Hsien Tzou (Institut Henri Poincare, Paris). Cahiers Phys., 17: 48-65(Jan. 1963). (In French)

The possibility of a generalization of the functions of wave i-complexes in the usual quantum theory to doubly complex functions as to quaternions is examined. In both cases, each wave function has four independent components and represents four particle states (two particles and their antiparticles) constituting a particle doublet. Some selection rules in good agreement with experimental data on leptons are obtained. (D.C.W.)

10902 CONTRIBUTION TO THE STUDY OF PROPERTIES OF SCATTERING WITH POTENTIALS OF THE GENERALIZED YUKAWA TYPE. Henri Cornille. Cahiers Phys., 17: 209-64(May-June 1963). (In French)

The iteration properties of solutions of the Schrödinger equation are extended for Yukawa-type potentials, and analyticity properties associated with scattering by a Yukawa-type potential are developed. (D.C.W.)

10903 STUDY OF THE PHYSICAL INTERPRETATION OF OPERATORS IN THE RELATIVISTIC QUANTUM MECHANICS OF SPIN PARTICLES. M. Baktavatsalou. Cahiers Phys., 17: 265-304(July 1963). (In French)

It is shown that operators that are observables can be obtained in relativistic quantum mechanics; and the operators are determined for electrons, bosons of spin 0 or 1, and particles of arbitrary spin and nonzero mass. The definition and interpretation of the position operators, specifically, are treated. (D.C.W.)

10904 RESONANCES AND ISOSPACE $\mathfrak{X}(R_3^c)$. Pierre Hillion (Institut Henri Poincare, Paris). Cahiers Phys., 17: 319-32(Aug. 1963). (In French)

It is shown that the known resonances (excepting η, ρ, and ω in the multipion system) can be described in the isospace $\mathfrak{X}(R_3^c)$ by polynomials obtained from other polynomials characterizing the elementary particles. The resonances are classified according to their baryon numbers, strangeness, and isobaric spin. Their decay modes are given, including some branching ratios. (D.C.W.)

10905 THEORY OF THE NEUTRINO AND C, P, T TRANSFORMATIONS OF A SPACE-TIME CURVE. André Lichnerowicz and Francoise Moret-Bailly (Collège de France, Paris). Compt. Rend., 257: 3542-5(Dec. 4, 1963). (In French)

The field of neutrinos on a space-time curve is derived, and the corresponding rigorous anticommutators are constructed from the results obtained previously (Lichnerowicz, Compt. rend. 252, 3742(1961)). The C, P, and T transformations are described. (tr-auth)

10906 LEPTON DECAYS OF K MESONS AND Σ HYPERONS. Pierre Hillion. Compt. Rend., 257: 3572-5 (Dec. 4, 1963). (In French)

The rule $\Delta Q = \pm \Delta S$ is studied by calculating the branching ratios of the lepton decays for K mesons and Σ hyperons within the framework of the theory of weak interactions previously proposed (Nuclear Phys. 40, 495(1963)). (tr-auth)

10907 THE TWO NEUTRINOS. Károly Nagy (Eotvos Lorand Univ., Budapest). Fiz. Szemle, 13: 9-13(Jan. 1963). (In Hungarian)

In order to explain the contradictions observed in the energy spectrum of electrons and positrons emitted during β decay, the existence of the neutrino was postulated by W. Pauli in 1933. Dirac equations require the existence of the antineutrino: both particles are electrically neutral, with a spin of $\frac{1}{2}$, while their mass and magnetic moment are zero. Double β decay was considered useful for differentiating between these two similar particles, which are considered as being identical by the theory of E. Majorana. The available experimental data support Dirac's neutrino theory but the methods used were not sensitive enough to state unequivocally that the neutrino and the antineutrino are not identical. A. Salam, L. Landau, T. D. Lee, and C. N. Yang developed simultaneously the 2-component neutrino theory, according to which a given neutrino has only one spin state, in which the spin and the pulse are antiparallel, defining jointly the helicity of the neutrino. More recently, G. Danby et al., proved experimentally the existence of two types of neutrinos on the basis of the $\pi \rightarrow \mu + \gamma'$ decay. (Review article, 16 references). (TTT)

10908 ONE-PHOTON EMISSION OF POSITRONS. Ferenc Illés (Nuclear Research Inst., Hungarian Academy of Sciences, Debrecen). Fiz. Szemle, 13: 52-3(Feb. 1963). (In Hungarian)

The most characteristic property of positrons is their radiative interaction with electrons; among the various possible types of this reaction, the transformation into two γ quanta is the best known. The single-photon emission cannot take place in the absence of a third body, in view of the conservation of the quadrupole moment. High order-number nuclei are most suitable for use as such third bodies. Interaction of positrons with K-electrons creates γ quanta accompanied by x radiation, corresponding to the K-shell transfer; at identical positron energies, the cross section is much smaller in this case than in the case of 2-photon processes. Under nonrelativistic conditions, the cross section increases with the positron energy and is proportional with the fifth power of the order number. In the experimental measurements, advantage was taken of the fact that the hard γ radiation coincidence resulting from the interaction is followed by K (x) radiation. Further work is in progress on the experimental determination of the theoretically predicted angular distribution, using a thin target. (TTT)

10909 THE DESCRIPTION OF SCATTERING EXPERIMENTS AT HIGH ENERGIES. P. Beckmann (Institut für Kernphysik, Mainz). Fortschr. Physik, 11: 421-43(1963). (In German)

The general frame for describing scattering experiments is reviewed. An introduction to scattering amplitude and its relation to experimentally accessible effective cross sections are discussed. Conclusions from invariance requirements are presented. Characterization of the scattering state by beginning and ending configurations is described. (M.C.G.)

10910 THE STATISTICAL MODEL FOR THE COMPLETELY REDUCED S-MATRIX. H. Satz (Universität, Hamburg). Fortschr. Physik, 11: 445-67(1963). (In German)

The statistical theory proposed by Fermi, in the form generally employed, takes into account only the S-matrix structure resulting from the commutatively of S with the energy-momentum operator, i.e., makes explicit use only of energy and momentum conservation before the statistical hypothesis is introduced. Following an analysis of this theory, an extended statistical model was formulated, in which all kinematical properties of the S-matrix, including con-

servation of angular momentum, were taken into account before the statistical assumption was made. Within this framework it is possible to clarify the kinematical approximations made in order to obtain the usual statistical theory. The cross section $\sigma_n(W)$ for the production of n particles from two incoming particles with CMS energy W is determined by completely reducing the S-matrix according to the inhomogeneous Lorentz group; the form $\sigma_n(W) = (\pi/K^2) \sum_{j=0}^{\infty} (2j + 1) |S_n(j,W)|^2$ is obtained. For $|S_n(j,W)|^2$ the statistical equation $|S_n(j,W)|^2 = N(j,W)Q_n(j,W)$ is made, where $Q_n(j,W)$ is the n-particle phase space at constant total energy W and constant total angular momentum j, in the CMS and function N(j,W) is determined uniquely by the unitarity of the S-matrix. Thus a completely defined statistical model, which fulfills conservation of energy and momentum, angular momentum, and which takes into account, the unitarity for two to n particle processes, is obtained. In the usual theory a statistical expression is not available for the elastic amplitude and thus the restrictions from the unitarity condition cannot be used. Therefore the extended model modifies the results of the usual theory and gives further results which are not obtainable within the usual theory without additional assumptions. Previous proposals for a statistical model at fixed angular momentum were considered. Possible methods for the evaluation of the resulting phase space integrals are discussed; in the limiting cases of n = 2 and of n non-relativistic particles the integrals can be solved in a closed form. (auth)

10911 CYCLOTRON RADIATION OF CHARGED PARTICLES IN A DIPOLE MAGNETIC FIELD. A. A. Korchak and N. A. Lotova (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR and Lebedev Inst. of Physics, Moscow). Geomagnetism Aeronomy, 3: 27-31(1963).

The degree of polarization and the position angle of the cyclotron radiation from electrons in a dipole magnetic field are calculated in relation to the problem of detecting the electromagnetic radiation of radiation belts. Both the isotropic and the nonisotropic distribution of electrons relative to the magnetic field are examined. (auth)

10912 STRUCTURE OF THE BOUNDARY LAYER BETWEEN A MAGNETIC FIELD AND A PLASMA STREAM. Yu. S. Sigov and B. A. Tverskoy (Steklov Mathematical Inst., Academy of Sciences, USSR and Moscow State Univ.). Geomagnetism Aeronomy, 3: 32-6(1963).

The structure of the boundary layer between a plasma stream and a magnetic field is examined with consideration of the thermal scatter of ion velocities. Conditions under which charge separation and the electrostatic field can be neglected are elaborated. It is shown that thermal scatter of ion velocities leads to the formation of a thin layer of high particle concentration at the boundary with the magnetic field. The spatial behavior of the major physical characteristics of the boundary layer and their dependence on the ratio of the average thermal velocity to the velocity of the incident stream are examined. (auth)

10913 THE POLARIZATION OF SYNCHROTRON RADIATION IN A DIPOLE MAGNETIC FIELD. A. A. Korchak (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 324-7(1963).

The Stokes parameters of synchrotron radiation of relativistic electrons in a regular magnetic field are determined. Linear polarization with an isotropic distribution of particles is considered. (R.E.U.)

10914 DEVELOPMENT AND SOLUTION OF INTEGRAL EQUATIONS FOR K^+ MESON DECAY AMPLITUDES τ^+ AND τ'^+. V. A. Shakhbazyan. Izv. Akad. Nauk Arm. SSR, Ser. Fiz.-Mat. Nauk, 16: No. 5, 107-18(1963). (In Russian)

Integral equations were developed for K meson 3π decay amplitudes. The equations reduced Feynman diagrams to one-variable functions. A one-dimensional mandelstam concept was used for developing the equation of S amplitudes for stable nonspin particle (π meson) elastic scattering. The method eliminates the divergences encountered with Feynman diagrams. (R.V.J.)

10915 ON THE THEORY OF BOSONS WITH ZERO REST MASS. Yu. A. Popov (Patrice Lumumba Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 5, 3-5 (1963). (In Russian)

A ten-dimensional system of photon field theory was analyzed. It is shown that normalization of the wave function forbids longitudinal photon states. Functions were developed for all permissible states, and the polarization vector was determined. (tr-auth)

10916 ON THE PRODUCTION OF HYPERONS IN NUCLEON-NUCLEON INTERACTIONS. V. A. Lyul'ka (Kurchatov Inst. of Nuclear Energy, Academy of Sciences, USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 5, 55-7(1963). (In Russian)

A one-π polar approximation was used in calculations of recoil proton spectra in $p + p \rightarrow p + \Lambda + K^+$ reactions at 2.85 Bev. (R.V.J.)

10917 RADIATION POLARIZATION PROPERTIES OF FAST ELECTRONS WITH ORIENTED SPIN IN MAGNETIC FIELD. I. M. Ternov, V. G. Bagrov, and R. A. Rzaev (Moscow State Univ.). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 5, 127-39(1963). (In Russian)

Radiation polarization properties of relativistic electrons in magnetic fields were investigated considering electron and photon spin correlation. Developed formulas describe linear and circular polarization that hold for any arbitrary electron energy, including the maximum ultrarelativistic region. (tr-auth)

10918 SEPARATION OF ANGULAR VARIABLES IN THE BETHE-SALPETER EQUATION FOR TWO SPIN-1/2 PARTICLES. Marian Guenther (Boeing Scientific Research Labs., Seattle). J. Math. Phys. (N. Y.), 5: 188-92 (Feb. 1964).

The Bethe-Salpeter equation for two fermions, in its usual differential form, is reduced to one that involves a single spatial and a single temporal variable. Concomitantly, the original underlying 16-dimensional spinor space is reducible to one of 8 dimensions for angular momentum $l \neq 0$ and of 4 dimensions for $l = 0$. The possibility of this reduction drives from the existence of one (or two) normal divisors of the matrices operating on the original spinor space, in these respective cases. The procedure is illustrated with the positronium problem, but may easily be seen to be quite general. (auth)

10919 REGGE BEHAVIOR OF FORWARD ELASTIC SCATTERING AMPLITUDES. James D. Bjorken (Stanford Univ., Calif.). J. Math. Phys. (N. Y.), 5: 192-8(Feb. 1964).

A theorem concerning the asymptotic behavior of forward elastic scattering amplitudes in relativistic theories is stated and proved. The assumptions made are (1) identical spinless particles interact via $G\phi^3$ and $\lambda\phi^4$ couplings; (2) a cutoff of the propagators is introduced; (3) the forward scattering amplitude satisfies a Bethe-Salpeter equation in the crossed channel; (4) the kernel of the equation is an

arbitrary finite subset of the Feynman graphs that compose the exact kernel. The theorem states that under these assumptions, the forward scattering amplitude exhibits Regge behavior, i.e., $A(s,0) \to s^{\alpha} + 0(1)$ as $s \to \infty$. (auth)

10920 SOME PROPERTIES OF TRIANGULAR REPRESENTATIONS OF SU(3). S. P. Rosen (Purdue Univ., Lafayette, Ind.). J. Math. Phys. (N. Y.), 5: 289-93(Feb. 1964).

The occurrence of an equal-spacing mass rule in the unitary decuplet can be explained either by observing that the isotopic spin and hypercharge of each particle are related by $T = \lambda + \frac{1}{2}Y$, or by making use of a theorem due to Diu and Ginibre. This theorem states that, in all triangular representations of SU(3), the matrix elements of an arbitrary tensor operator depend upon one reduced matrix element instead of two. A proof of the Diu-Ginibre theorem is presented and it is shown that relations of the form $T = \lambda \pm \frac{1}{2}Y$ exist for all triangular representations. It is also shown that the L and K spins are related to their corresponding hypercharges by $L = \lambda \pm \frac{1}{2}Y_L$ and $K = \lambda \pm \frac{1}{2}Y_K$. One consequence is that the masses and magnetic moments of particles in a triangular multiplet are equally spaced. Other consequences are also discussed. (auth)

10921 K^--DECAY BRANCHING FRACTIONS. W. Becker, M. Goldberg, E. Harth, J. Leitner, and S. Lichtman (Syracuse Univ., N. Y.). Nuovo Cimento (10), 31: 1-6 (Jan. 1, 1964).

The K^- decay branching fractions for the μ_2, π_2, τ, and 3-body modes are determined. The decay fractions are compared with all available values of their equivalents for K^+ decay. The determination agrees well with the emulsion results and disagrees with the recent Xe results by approximately 2 standard deviations. Possible reasons for this discrepancy are discussed. (auth)

10922 INVESTIGATION OF SPURIOUS SCATTERING IN NUCLEAR EMULSION. J. J. Jones and R. M. Kalbach (Univ. of Arizona, Tucson). Nuovo Cimento (10), 31: 10-26(Jan. 1, 1964).

Properties of spurious scattering in nuclear emulsion were investigated using protons of 19.8 and 24 Bev/c from the external beam of the CERN Proton Synchrotron. The variation of the spurious scattering signal with cell lengths of 2 to 12 millimeters and dip angles of 0 to 3 degrees is investigated, and a functional relation describing the observed variation is presented. A simple method for measuring momenta is presented that takes advantage of the observation that this functional relation for the spurious scattering fits the results of other investigators working with a similar range of momenta. Evidence is presented that indicates that the spurious scattering is enhanced when using an oil immersion lens, presumably due to the absorption of oil by the emulsion. (auth)

10923 CALCULATION OF THE K^* PARAMETERS FROM NEARBY SINGULARITIES. B. Diu, J. L. Gervais, and H. R. Rubinstein (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cimento (10), 31: 27-41(Jan. 1, 1964).

A numerical attempt is made to calculate the K^* mass and width from one-particle exchange forces. Due to the appearance of an extra parameter, a family of solutions is obtained, both in the one-channel (π + K) and the two-channel (π + K and η + K) cases. Though mass and width can be well reproduced, the generating coupling constants come much too large. This raises some objections to the "bootstrap" generation of particles. (auth)

10924 PARTIAL-WAVE ANALYSIS OF THE REACTION: $\pi^- + p \to K^0 + \Lambda^0$. M. Rimpault (Faculte des Sciences, Bordeaux). Nuovo Cimento (10), 31: 56-74 (Jan. 1, 1964).

A method of calculation is described that permits obtaining directly, up to a phase factor, a set of a partial-wave amplitudes from experimental data for angular distribution and polarization. The phase factor is determined by assuming the existence of a resonant F_{5} state, and the consistency of the assumption with previous results is shown. The peak of the total cross section can then be explained by an important decay mode of the third π-nucleon resonance into the $K^0\Lambda^0$ state. Some values for the baryon-meson coupling constants are given. (auth)

10925 THE SELECTION RULES IN THE FEINBERG AND PAIS FIELD THEORY OF WEAK INTERACTIONS. C. Bouchiat, B. d'Espagnat, and J. Prentki (CERN, Geneva). Nuovo Cimento (10), 31: 75-87(Jan. 1, 1964).

The peratization method of Feinberg and Pais is applied to semileptonic processes. A matrix formalism is presented that makes it possible to treat these processes in a way closely similar to the simpler case of the purely leptonic processes. It is shown that, when peratization is applied to contributions of the higher order graphs, the concept of universality and the CVC theory remain meaningful, and the set of selection rules implied by a one-boson-exchange approximation remains unchanged to the order g^2. In particular, if the fundamental Lagrangian involves no $\Delta S = -\Delta Q$ or $|\Delta S| = 2$ currents, such selection rules as $\Delta S/\Delta Q = 1$ and $\Delta S \neq 2$ are still valid. (auth)

10926 π-π SCATTERING IN THE BOUNDARY-CONDITION MODEL. W. W. S. Au and E. L. Lomon (Massachusetts Inst. of Tech., Cambridge). Nuovo Cimento (10), 31: 113-31(Jan. 1, 1964). (TID-19417)

The boundary-condition model is used to generate pion-pion amplitudes in the T = 0 and 2 S-states and the T = 1 P-state. The parameters of the model are restricted by three crossing symmetry conditions at the symmetry point, reducing the number of independent parameters to as few as three. The remaining parameters are used to fit the data available from multipion production experiments. Conclusions are obtained with respect to the distribution of Yukawa potentials of range $\sim 0.5\mu^{-1}$, and the boundary conditions at a radius $\leq 0.25\mu^{-1}$. The P-state model has a repulsive potential tail and an attractive core. It leads to the asymmetry of the ρ-mass distribution seen in some experiments. Contributions from ω decay are not required. The T = 2 S-state results tend toward a hard core with an attractive tail. The model of the T = 0 S-state interaction can be either a nonresonanting constant boundary condition with tail, or a resonanting pole-type boundary condition. (auth)

10927 STATISTICAL MECHANICAL EVALUATION OF PHASE-SPACE INTEGRALS. F. Lurcat and P. Mazur (Institut des Hautes Etudes Scientifiques, [Orsay, France]). Nuovo Cimento (10), 31: 140-63(Jan. 1, 1964).

A method based on the formalism of statistical mechanics is presented that yields for phase-space integrals and related quantities an asymptotic expansion valid for $N \to \infty$. It appears that, by retaining only the first two terms of this expansion, approximate expressions are obtained that give satisfactory estimates even at low multiplicities (for instance, at N = 5 the relative error is ~1%). The formulas for the practical evaluation of covariant phase-space integrals, according to this method are listed. (auth)

10928 ON ELECTROPRODUCTION OF STRANGE PARTICLES ON NUCLEONS. G. Bialkowski (Università, Turin). Nuovo Cimento (10), 31: 164-86(Jan. 1, 1964).

The electroproduction of strange particles on nucleons is discussed from the point of view of the dispersion theory. Preliminary calculations concerning the kinematics and the multipole expansions are made. A specific model is assumed based on the simplifying supposition that only the resonant states in all the three channels are important. (auth)

10929 EXACT SOLUTIONS OF THE BETHE-SALPETER EQUATION FOR FERMIONS. W. Kummer (CERN, Geneva). Nuovo Cimento (10), 31: 219-46(Jan. 1, 1964).

The properties of the Bethe-Salpeter equation (B. S.) for two fermions with equal masses mediated by a massless vector particle $\gamma_5\gamma_\mu$ model are investigated in the ladder approximation. For vanishing total energy of the bound state, sets of eigensolutions of the homogeneous B. S. equation are obtained. Arguments are given that one of these belonging to discrete eigenvalues of the coupling constant can be called a bound state, whereas the other continuous sets lack in some properties, attributed to bound states of the usual sense. (auth)

10930 EXPERIMENTAL RESULTS ON THE I = 2 $\pi\pi$ SCATTERING CROSS-SECTION. N. Schmitz (Max-Planck-Institut für Physik und Astrophysik, Munich). Nuovo Cimento (10), 31: 255-7(Jan. 1, 1964).

The one-pion-exchange in $\pi^-p \to \pi^+p\pi^-\pi^-$ is used to study $\pi^-\pi^- \to \pi^-\pi^-$ by relating the four-momentum transfer to the cross section. (R.E.U.)

10931 ON THE Y* (1765 Mev). S. Minami (Louisiana State Univ., Baton Rouge). Nuovo Cimento (10), 31: 258-61(Jan. 1, 1964).

The existence of two resonances in the neighborhood of 1800 Mev in $\bar{K}^- + n \to \bar{K}^- + \pi^- + p$ is confirmed. The quantum numbers of Y* (1765) are determined, and Y* (1765) + π or Y* (1815) + π production is decided upon for $\bar{K}$-N collisions. The theoretical properties of Y* (1765) are discussed. (R.E.U.)

10932 AN ATTEMPT OF DETERMINATION OF THE F/D RATIO FOR BARYON-VECTOR MESON OCTET COUPLING FROM NUCLEON ELECTROMAGNETIC FORM FACTORS. W. Alles (CERN, Geneva) and S. Bergia. Nuovo Cimento (10), 31: 262-4(Jan. 1, 1964).

The number of parameters of a fit of nucleon electromagnetic form factors is reduced using SU(3) symmetry and ω-φ mixing. A definite relation is given for the $\omega_8\gamma$ and $\rho\gamma$ coupling constants, and the vector meson octet coupling to the baryon current is given as a function of F and D coupling constants. (R.E.U.)

10933 π^--Λ^0 INTERACTIONS AT 4.5 Gev. S. Feminò, S. Jannelli, and F. Mezzanares (Università, Messina, Italy and Istituto Nazionale di Fisica Nucleare, Messina, Italy). Nuovo Cimento (10), 31: 273-80(Jan. 16, 1964).

An emulsion study was made of π^--Λ^0 interactions at 4.5 Bev. 530 m of track were scanned and the total cross sections were deduced: $\sigma_{tot}(\pi^-p) = (29.4 \pm 2.7)$ mb, $\sigma_{tot}(\pi^-n) \geq (28.8 \pm 3.6)$ mb. The elastic, (2.6 ± 0.8) mb, and inelastic cross-sections at various multiplicities were also deduced. The angular and momentum distributions (c.m.s.) of the protons and pions suggest the peripheral collisions model as most adequate for explaining the interaction mechanism. Target mass appears to be 254 Mev/c^2. Other characteristic parameters of the events were also deduced; π^0 to π_{tot} ratio is about 60%. (auth)

10934 NEUTRON ELECTROMAGNETIC FORM FACTORS. G. Bialkowski (CERN, Geneva). Nuovo Cimento (10), 31: 325-31(Jan. 16, 1964).

The deuteron wave function is constructed previously is applied after slight modifications to the calculations of the neutron electromagnetic form factors on the basis of existing experimental data for elastic scattering of electrons on deuterons. Numerical results are presented in the very-low momentum transfer region where the theory is supposed to be able to fit the data. (auth)

10935 SOME REMARKS ABOUT "BOOTSTRAP" CALCULATIONS. B. Diu, J. L. Gervais, and H. R. Rubinstein (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cimento (10), 31: 341-59 (Jan. 16, 1964).

The so-called bootstrap technique is studied in the $\pi + \pi$ and K + K amplitudes, using the first iteration of the N/D method with elastic unitarity. Though the qualitative features come out correct, quantitative agreement cannot be reached. In particular, the self-consistent calculation of ρ parameters is shown to be more model-dependent than was expected previously. A radical improvement in the ρ mass took place when a coupled two-channel $\pi\pi$-$\pi\omega$ problem was solved. It is shown that such a result is critically dependent on the way forces are chosen (neglecting the $\pi\pi \to \omega\omega$ forces is instrumental to obtain that type of solutions). Moreover, the $\pi\pi$-$K\bar{K}$ problem is seen to behave quite differently. Some predictions of very limited scope are made on possible KK resonances. (auth)

10936 CUTS AND POLES IN THE ANGULAR-MOMENTUM PLANE. C. Wilkin (Univ. of Birmingham, Eng. and CERN, Geneva). Nuovo Cimento (10), 31: 377-96(Jan. 16, 1964).

The class of diagrams for which Amati, Fubini, and Stanghellini propose the existence of cuts in the angular-momentum plane, is studied with the aid of the solution of the Bethe-Salpeter equation in the ladder approximation. Although it is found that these cuts do not exist, the same method shows that cuts are present in a set of diagrams suggested by Mandelstam. (auth)

10937 A DISCRETE SUBGROUP FOR HIGHER-SYMMETRY MODELS. N. T. Evans (Univ. of Auckland, N. Z.). Nuovo Cimento (10), 31: 414-19(Jan. 16, 1964).

It is shown that in a higher-symmetry model based on a compact semi-simple Lie group, the strong interactions are invariant under a discrete subgroup. The associated symmetry transformations are related to the transformations induced on the weight diagrams by elements of the Weyl group. Such symmetries lead to simple predictions of certain relations among the electromagnetic form factors of the hadrons. (auth)

10938 THE CROSSING MATRIX IN THE OCTET MODEL. J. J. De Swart (CERN, Geneva). Nuovo Cimento (10), 31: 420-6(Jan. 16, 1964).

A general expression is given for the elements of the crossing matrix in the octet model in terms of the Clebsch-Gordan coefficients for SU(3). Several useful relations about the crossing matrices are derived. For two specific cases the crossing matrix is given. (auth)

10939 REMARK ON OPERATIONAL FORMULATIONS OF RELATIVISTIC CAUSALITY. I. E. Segal (Massachusetts Inst. of Tech., Cambridge). Nuovo Cimento (10), 31: 427-8(Jan. 16, 1964).

It is pointed out that the so-called usual causality condition described in an article by Taylor and Toll criticiz-

ing the consideration of another condition is rather obviously vacuous. While in accord with their contention of a difference between the conditions, this shows that the difference is an essential advantage of the condition, and renders invalid the treatment of dispersion relations in the cited article as well as in earlier work of one of the authors cited in the article. (auth)

10940 CROSS-SECTION FOR HYPERON PRODUCTION BY NEUTRINOS. F. Chilton (Stanford Univ., Calif.). Nuovo Cimento (10), 31: 447-51(Jan. 16, 1964).

The cross section, differential in q^2, is calculated for hyperon production by neutrinos (or any other spin ½ to spin ½ reaction). All six form factors are included. A closed form for the total cross section is given in the form of an expansion about the asymptotic value assuming a q^2 dependence of the form factors like $(1 - q^2/a^2)^{-2}$. (auth)

10941 ON THE AZIMOV CONDITIONS FOR NUCLEON-NUCLEON SCATTERING. J. M. Charap (CERN, Geneva). Nuovo Cimento (10), 31: 452-61(Jan. 16, 1964).

The analytic continuation of the partial-wave scattering amplitudes for nucleon-nucleon elastic scattering is stated. The Gribov-Pomeranchuk-Azimov essential singularity at J = 0 is investigated, and by considering the two-meson exchange contributions it is shown that Azimov's conditions for the absence of the essential singularity are not satisfied. (auth)

10942 TABLES OF ELEMENTARY PARTICLES AND RESONANT STATES, NOVEMBER 1963. M. Roos (Nordita, Copenhagen). Phys. Letters, 8: 1-4(Jan. 1, 1964).

The charges, quantum numbers, masses, and decay characteristics of the particles and states are tabulated. Also the antiparticles, mean lives, and magnetic moments are included for the elementary particles, as are the widths, lifetimes, and production characteristics for the resonant states. (D.C.W.)

10943 A POSSIBILITY OF OBTAINING HIGH ENERGY POLARIZED ELECTRONS BY REFLECTING LIGHT FROM MOVING ELECTRONS. V. M. Harutyunian, F. R. Harutyunian, and V. A. Tumanian (State Committee Physical Inst. for the Use of Atomic Energy, Erivan). Phys. Letters, 8: 39-40(Jan. 1, 1964).

The production of polarized electrons by reflecting circularly polarized light (laser beam) from moving electrons is proposed. The final electrons would be polarized if the recoil were sufficient. Calculations of the polarization as a function of scattered electron energy are included. (D.C.W.)

10944 POSSIBLE CHARGE DEPENDENCE OF NUCLEON-NUCLEON PHASE SHIFTS. P. Signell (Pennsylvania State Univ., University Park). Phys. Letters, 8: 73(Jan. 1, 1964).

Phase shifts were calculated in a semi-theoretical model setting the quantum mass sequentially equal to the neutral pion mass and the charged pion mass. The results show that analysis under the assumption of charge independence may give false p-p phase values. (D.C.W.)

10945 STUDY OF THE REACTION $\pi^- p \rightarrow \pi^0 +$ (CHARGE) BETWEEN 0.5 AND 1.5 Gev/c. J. F. Detoeuf, Y. Ducros, J. P. Merlo, A. Stirling, B. Thevenet, L. Van Rossum, and J. Zsembery (CEN, Saclay, France). Phys. Letters, 8: 74-7(Jan. 1, 1964). (In French)

The angular distribution of gamma rays in the π^- + p interactions was obtained. Integration of the distribution, with appropriate corrections, gave the effective cross section for $\pi^- p \rightarrow \gamma$ + charged particles from which the effective cross section for $\pi^- p \rightarrow \pi^0$ + charged particles was obtained. Analysis of the total cross section in terms of an I = ½ resonance causing its maximum at 730 Mev/c indicated an assignment of J = ⅜ for the 730-Mev/c resonance. (D.C.W.)

10946 A LOWER BOUND FOR LARGE ANGLE ELASTIC SCATTERING AT HIGH ENERGIES. F. Cerulus (Universite, Louvain, Belg.) and A. Martin. Phys. Letters, 8: 80-2(Jan. 1, 1964).

An upper bound for the modulus of the forward scattering amplitude is derived. (auth)

10947 UNITARY SYMMETRY AND NON-LEPTONIC K-DECAYS. Y. S. Kim and S. Oneda (Univ. of Maryland, College Park). Phys. Letters, 8: 83-5(Jan. 1, 1964).

The implications for meson(K) decay processes of the assumption that the weak nonleptonic interaction hamiltonian, together with the pseudoscalar and vector mesons, belongs to the SU(3) octet are examined. (D.C.W.)

10948 MEASUREMENT BY BREMSSTRAHLUNG TRANSMISSION OF THE POLARIZATION OF e^+ FROM $\mu^+ \rightarrow e^+ + \nu_e + \bar{\nu}\mu$. S. Bloom, L. A. Dick, L. Feuvrais, G. R. Henry, P. C. Macq, and M. Spighel (CERN, Geneva). Phys. Letters, 8: 87-9(Jan. 1, 1964).

The polarization of the positron was measured by observing the transmission through magnetized iron of circularly polarized bremsstrahlung from the positron. The positrons were found to be right-handed with a polarization of 94 ± 38%, in agreement with the prediction of the V-A theory. (D.C.W.)

10949 ENERGY OF THE MANY-FERMION NORMAL SYSTEM. Kleber S. Masterson, Jr., and Katuro Sawada (Univ. of California, La Jolla). Phys. Rev., 133: A1234-44(Mar. 2, 1964).

Perturbation theoretic equations for several properties of the zero-temperature many-fermion normal system are rederived from general considerations. Though none of the equations are new, some of the derivations are, and taken together they form a brief and simple summary of many-fermion relations and a basis for further investigation of the basic perturbation description of the many-fermion normal system: the Brueckner-Goldstone expansion. A change-of-parameter technique is then developed and employed to investigate the possible use of the true momentum density instead of the unperturbed fermi distribution in the Brueckner-Goldstone expansion and in the Brueckner K-matrix approximation. The result is a simpler, approximate perturbation series for the interaction energy, whose accuracy for nuclear matter is estimated to be approximately ±2 Mev. The new approximation is exact to the fourth order. (auth)

10950 REPULSIVE BARDEEN-COOPER-SCHRIEFFER PAIR-INTERACTION. K. Sawada and C. Warke (Univ. of California, La Jolla). Phys. Rev., 133: A1252-6(Mar. 2, 1964).

With the mere use of the sum rules, the effect of interaction on the energy and one-particle momentum distribution of a system of Fermi particles, interacting with the repulsive BCS-type pair interaction, is investigated with the assumption that the coupling constant is of order one, together with the case when the coupling constant is of the order $1/\Omega$ (Ω being the volume of the quantization box) which was treated earlier by Van Hove in connection with the question of sharpness of Fermi surface. It is observed that in some region of density, this type of interaction has no effect

on the energy and sharpness of the Fermi sphere, and above critical density the system will go over a phase change, but still the Fermi sphere remains rigid. (auth)

10951 K_1-K_2 MASS DIFFERENCE AND A POSSIBLE DI-PION RESONANCE AT ABOUT 400 Mev. K. Nishijima (Univ. of Illinois, Urbana). Phys. Rev. Letters, 12: 39-41 (Jan. 6, 1964).

It is shown that in three-pion decays of the η and K mesons, assuming the existence of an I = J = 0 dipion resonance of 400-Mev mass, the resonance would necessarily make the K_1 meson heavier than the K_2 meson. A dispersion-theoretical formulation presented previously is recapitulated. (R.E.U.)

10952 POSSIBLE INTERPRETATION OF THE $\pi\omega$ RESONANCE AT 1220 Mev. Ronald F. Peierls (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 12: 50-2(Jan. 13, 1964). (BNL-7639)

A previously reported resonance in interactions of π with ω mesons at 1220 Mev with a 100-Mev width and assumed π,ρ,ω coupling is interpreted as the direct analog for the $\pi\omega$ system of the 33 isobar observed in π-nucleon interactions, and its spin and parity should be 2^-. (R.E.U.)

10953 NUCLEON-NUCLEON SCATTERING AND THE MESON RESONANCES. P. B. Kantor (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 12: 52-4 (Jan. 13, 1964). (BNL-7536)

The approximation of nucleon-nucleon scattering amplitudes with mesonic resonances is discussed. Singlet amplitudes only are considered in the dispersion relations obtained from the Cauchy theorem's application to Mandelstam-represented scattering amplitudes. An indirect procedure is used to compare the solution of the dispersion relation to experiment. (R.E.U.)

10954 DYNAMICS OF THE π-ω RESONANCE. Ernest Abers (California Inst. of Tech., Pasadena). Phys. Rev. Letters, 12: 55-6(Jan. 13, 1964).

A dynamical model for π-ω scattering is presented that indicates a 1^+ $\pi\omega$ resonance at 1220 Mev, including the absence of its decay into two pseudoscalar mesons or into $\pi+\varphi$. The model is dominated by ρ exchange and is capable of predicting an axial-vector $\pi\omega$ resonance, which may be the previously studied B meson. (R.E.U.)

10955 INTERMEDIATE BOSONS: PRODUCTION CROSS SECTION FROM NEUTRINOS. Alfred C. T. Wu (Univ. of Michigan, Ann Arbor), Chen-Ping Yang, Kurt Fuchel, and Sidney Heller. Phys. Rev. Letters, 12: 57-61 (Jan. 13, 1964). (BNL-7622)

A summary is presented of numerical computations of intermediate boson (W) production cross sections in high-energy neutrino experiments. The efficiency and accuracy of the numerical computations are improved to permit processing of large numbers of theoretical cross sections that might be of interest in determining the boson mass (M_W) and anomalous magnetic moment. An IBM-7094 two-dimensional integration is involved. Results are given for E_ν = 1.5 to 4 Bev for M_W = 1.0 to 1.5 Bev from Al^{27} and $Cu^{63.5}$. (R.E.U.)

10956 Σ-RADIATIVE DECAY AS A METHOD OF DETERMINING THE ANGULAR MOMENTUM OF THE Σ-PIONIC DECAY. Saul Barshay (Rutgers Univ., New Brunswick, N. J.), Uriel Nauenberg, and Jonas Schultz. Phys. Rev. Letters, 12: 76-9(Jan. 20, 1964).

A way of determining experimentally which of the Σ-hyperon pionic decays occurs via the S-wave and which via the P-wave channel is discussed. This presents a test for the $\Delta I = \frac{1}{2}$ rule for nonleptonic decays. The calculation of the momentum distribution for the pion in the sigma center-of-mass system in the decay $\Sigma^+ \to n + \pi^+ + \gamma$ is presented. The relevance of the radiative decay in determining the angular momentum of the $\Sigma^+ \to \pi^+ + n$ decay channel is emphasized. (R.E.U.)

10957 REMARKS ON CABIBBO'S THEORY OF WEAK INTERACTIONS. J. J. Sakurai (Tokyo Univ. and Univ. of Chicago). Phys. Rev. Letters, 12: 79-81(Jan. 20, 1964).

Cabibbo's theory of leptonic decays of strange particles based on the octet version of unitary symmetry is discussed. Some disagreements are presented, and it is pointed out that because of the approximate nature of unitary symmetry, an exact agreement with experiment is not expected. Corrections to Cabibbo's mixing angle in the beta-decay constant and a discussion of the vector and axial-vector parts are presented. (R.E.U.)

10958 DIFFRACTION PATTERNS FOR INELASTIC ELEMENTARY PARTICLE PROCESSES. A. Dar (Weizmann Inst. of Science, Rehovoth, Israel), M. Kugler, Y. Dothan, and S. Nussinov. Phys. Rev. Letters, 12: 82-3(Jan. 20, 1964).

The possible application of optical diffraction to inelastic processes where strong absorptive competing channels are open, as in nucleon-antinucleon scattering because of large annihilation probability in collisions with small impact parameters, is discussed. Results are given for $\bar{p} + p \to \bar{n} + n$ at 0.9 Bev/c and $\bar{p} + p \to \bar{\Lambda} + \Lambda$ at 3.3 Bev/c. (R.E.U.)

10959 TRANSFORMATION PROPERTIES OF NON-LEPTONIC WEAK INTERACTIONS. Benjamin W. Lee (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Letters, 12: 83-6(Jan. 20, 1964).

The $\Delta T = \frac{1}{2}$ rule for nonleptonic decays of strange particles requiring the part of the Hamiltonian $H_W(\Delta S = +1)$, responsible for these decays with $\Delta S = 1$, to transform like the K^* meson with respect to the hypercharge gauge transformation and isospin rotations is discussed. It is proposed that $H_W(\Delta S = +1)$ transforms like the K^* meson with respect to all SU(3) transformations, and $H_W[H_W = H_W(\Delta S = +1) + H_W(\Delta S = -1)]$ is approximately invariant under the product of parity conjugation and R conjugation. The consequences of these proposals are discussed. (R.E.U.)

10960 COMPARISON OF A NEW SU_3 PREDICTION WITH EXPERIMENT. S. Meshkov (National Bureau of Standards, Washington, D. C.), G. A. Snow, and G. B. Yodh. Phys. Rev. Letters, 12: 87-92(Jan. 20, 1964).

A rule for reaction processes is proposed considering processes of two types: meson + proton → baryon resonance + meson, and meson + proton → baryon resonance + vector meson. Data for various reactions are compiled, and the reaction predictions of SU(3) are discussed. 22 references. (R.E.U.)

10961 RESONANCES IN MULTICHANNEL SYSTEMS. C. R. Hagen (Univ. of Rochester, N. Y.). Phys. Rev. Letters, 12: 153-5(Feb. 10, 1964).

The positions of the resonance poles associated with the spin $-\frac{3}{2}$ baryon decuplet that raises objections to the schemes of unitary symmetry are investigated. It was previously pointed out that in the I = 1, S = −1 channel the Y_1^* resonance must occur as a pole on the sheet obtained by passing through that portion of the unitary cut that lies between the $\pi\Sigma$ and $\bar{K}N$ thresholds. This problem is analyzed in terms of a nonrelativistic, two-channel, S-wave scattering amplitude. (C.E.S.)

10962 NONLEPTONIC WEAK DECAYS AND THE EIGHTFOLD WAY. Murray Gell-Mann (California Inst. of Tech., Pasadena). Phys. Rev. Letters, 12: 155-6 (Feb. 10, 1964).

Under the assumption that the strongly interacting particles approximately obey the eightfold way symmetry, the consequences of the further assumption that the weak interactions of baryons and mesons have simple transformation properties under the same symmetry is investigated. The weak decays $K_1^0 \rightarrow 2\pi$, $\Lambda \rightarrow p + \pi^-$, $\Xi^- \rightarrow \Lambda + \pi^-$, and $\Sigma^+ \rightarrow p + \pi^0$ are considered. (C.E.S.)

10963 LIOUVILLE EQUATION FOR A RELATIVISTIC CHARGED PARTICLE. F. Henin (Université Libre, Brussels). Physica, 29: 1233-65(Dec. 1963).

The Liouville equation for a relativistic charged particle interacting with its radiation field in the presence of an external electromagnetic field is derived. This equation is solved formally by an iteration procedure and the integration over the field variables is carried out. The evolution equation is obtained for the distribution function $\rho(t)$ of the particle alone; it involves perturbed propagators that are solutions of a nonlinear integral equation, and which properties are briefly discussed. An exact solution of the equation for $\rho(t)$ is then given; it is the distribution function for a particle whose motion is governed by the equations of classical electrodynamics, i.e., a particle acted upon by the Lorentz force due to the external field and the self-retarded field. The point character of the charge introduces divergent contributions to the Liouville equation. Within the Born approximation, it is shown how the regularization procedure used previously by I. Prigogine for the equations of motion can be introduced in the Liouville formalism. (auth)

10964 STRONGLY INTERACTING PARTICLES. Geoffrey F. Chew, Murray Gell-Mann, and Arthur H. Rosenfeld. Sci. Am., 210: 74-93(Feb. 1964).

Strong-interaction forces are placed in the hierarchy of the four forces that underlie all the operations of the physical universe. A nomenclature that assigns each of the strongly interacting particles to one of a small number of families, each characterized by a distinctive set of properties, is described. The seven quantum numbers conserved in strong interactions are reviewed. The conservation of these quantities is described when particles decay into different channels, representing different modes of decay. This leads to a description of resonances, or unstable particles. The Regge trajectory and eightfold way classification systems are discussed. The term "elementary" is shown to be inapplicable in the description of strongly interacting particles when these particles should be considered as composite structures. The "bootstrap" hypothesis is described and its advantages in the mathematical explanation of the existence and properties of the strongly interacting particles are discussed. Data on known and assumed particles and multiplets are given. (R.E.U.)

10965 DIAGRAM METHOD FOR CALCULATING AMPLITUDES OF NUCLEON-NUCLEON SCATTERING. V. V. Komarov and A. M. Popova. Vestn. Mosk. Univ., Ser. III, Fiz., Astron., No. 5, 18-23(Sept.-Oct. 1963). (In Russian)

Infinite integration of perturbation theory diagrams was used for developing equations for the amplitude of N-N scattering coinciding with the Schroedinger equations for two nucleon systems and for expressing N-N and S-scattering amplitudes at zero radius. (R.V.J.)

10966 ON A NEW TYPE OF BOND FOR LOCAL SCATTERING MATRIX OPERATORS. E. S. Lonskii and Yu. M. Shirokov. Vestn. Mosk. Univ., Ser. III, Fiz., Astron., No. 5, 58-66(Sept.-Oct. 1963). (In Russian)

A previously suggested method, Yu. M. Shirokov (Zh. Eksperim. i Teor. Fiz. 44: 203(1963)), for reducing the S-matrix according to the Heisenberg two-component matrix element in local operators was normalized to a nonrelativistic concept. Direct application of the Sharkov method developed all scattering phases except the S-phase. Expansion of the method permitted a calculation of the S-matrix. (R.V.J.)

10967 ON QUASI-OPTICAL METHODS IN FIXED SOURCE MESON THEORY. V. D. Kukin. Vestn. Mosk. Univ., Ser. III, Fiz., Astron., No. 5, 80-9(Sept.-Oct. 1963). (In Russian)

A quasi-optical method developed for quantum field theory by A. A. Logunov (Preprint JINR, E-1145, 1962) was applied to charged and symmetric scalar meson theory. It is shown that the method can be used for reducing the potential meson interaction with fixed nucleons to a series of renormalized bond constants. (R.V.J.)

10968 STUDIES ON X-AGENT. XXXII. SHIELDING EFFECTS OF METALLIC AND NON-METALLIC SUBSTANCES, AND ALSO INFLUENCES OF WATER, ON X-AGENT WITH RESPECT TO THE ACTION OF THE AGENT ON THE CLOUDINESS OF BISMUTH-OXYCHLORIDE SUSPENSION. Hideo Moriyama (Shonan Hygiene Inst., Kamakura, Japan). Yokohama Med. Bull., 14: 235-52(Oct. 1963).

The shielding effects of lead blocks, tin plate, and thick paper (card-board) on the X agent were investigated in respect to bismuth oxychloride clouding. A number of test tubes each containing the same suspension of bismuth oxychloride suspension were placed inside and outside small chambers made from lead blocks (5 cm thick), thin tin plate, and card-board. It was found that the suspension in each test tube became different from each other in cloudiness. The change is attributed to the action of X agent. The results support the view that the X agent is a group of abnormal electromagnetic waves of a very wide range of energies. Evidence is also presented to indicate that the X agent undergoes seasonal variation. (P.C.H.)

10969 TOTAL CROSS SECTION FOR INTERACTION BETWEEN NEUTRONS AND PROTONS AT 5.5 Bev. M. N. Khachaturyan and V. S. Pantuev (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 1808-10(Dec. 1963). (In Russian)

The total neutron-proton interaction cross section is measured at an effective energy of 5.5 ± 0.7 Bev and is found to be equal $\sigma_t = 41.2 \pm 1.7$ mb. The measurements were carried out by a difference method ($CH_2 - C$) under good geometrical conditions ($0/2 = 0.228°$).

10970 SPECTRA OF CHARGED MESONS EMITTED AT AN ANGLE OF 90° IN np-COLLISIONS INVOLVING ~600 Mev NEUTRONS. K. O. Oganesyan and V. A. Yarba (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 1835-8(Dec. 1963). (In Russian)

The energy spectra of charged mesons emitted at an angle of 90° in the laboratory system as a result of the $n + p \rightarrow \pi^{\pm} + \ldots$ reaction induced by ~600-Mev neutrons are measured with a photographic emulsion chamber. The ratio of π^+- and π^--meson yields are measured, and found to equal 0.94 ± 0.10. The results agree with those of measurements performed on a magnetic spectrometer. (auth)

10971 ON INELASTIC PROCESSES DUE TO VARIOUS TYPES OF MOVING POLES. I. M. Dremin and D. S. Chernavskii (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 45: 1943-50(Dec. 1963). (In Russian)

Inelastic peripheral high energy interactions due to exchanges of various types of poles (pions, kaons, and vacuum regions) are considered from a unified viewpoint, from that of amplitude poles in the complex angular momentum plane. It is demonstrated that in the region in which effects related to the motion of poles described by these quanta are important, the overwhelming part of the contribution is from the vacuum region. However the contribution from this whole region decreases logarithmically with energy and the production multiplicity is small. In the region which yields the main contribution to the cross section these pole motion effects do not play any role. Here the main contribution is from single-pion exchange as computed in the one-meson approximation. This circumstance is related to the difference in kinematics of elastic and inelastic processes. Some criteria are considered that can be employed for differentiating between inelastic processes due to vacuum region exchange and processes due to meson exchange. (auth)

10972 DECAYS OF THE HYPERNUCLEUS Σ^+p. V. A. Filimonov (Tomsk Polytechnical Inst., USSR). Zh. Eksperim. i Teor. Fiz., 45: 1954-9(Dec. 1963). (In Russian)

The probabilities for the decay of the hypernucleus Σ^+p into $d + \pi^+$, $2p + \pi^0$, and $p + n + \pi^+$ are calculated. The $d + \pi^+$ decay probability strongly depends on the binding energy and spin of Σ^+p. Measurement of the probability of this decay can be employed for ascertaining whether π^+-decay of free Σ-hyperons proceeds via the s- or p-state. The spectrum of π-mesons in three particle decays is discussed. (auth)

10973 K_{e5}-DECAY. V. A. Kolkunov and I. V. Lyagin (Inst. of Physics and Tech., Kazan Branch, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 2009-14 (Dec. 1963). (In Russian)

The probabilities for K_{e5}-decay are calculated for the case of direct interaction and for interaction between the reaction particles via an intermediate η-meson. Isotopic relations for various charge channels of the reaction are considered on basis of the $\Delta T = 1/2$ rule. (auth)

10974 A SOURCE OF POLARIZED IONS AND DETECTION OF THE POLARIZATION OF DEUTERONS. H. H. P. Jochim. Thesis, Erlangen, Ger., Universität, 1962. 25p. $2.00(Gmelin, AED-DISS. 62-562).

A deuterium source with high frequency circular discharge is described. Atoms with hyperfine structure level $-1/2$ are separated from the beam by a magnetic quadrupole field. Atoms with $+1/2$ are focused into an ion source and ionized in a magnetic field using a vacuum of 10^{-8} mm Hg. Deuterons from this source are accelerated through 100 kev. A tritium-titanium target is used for neutron production. From the ratio of neutron counts for angles of 0 and 90°, it is inferred that the polarization parameter has a value of 0.74. This ion source gives a deuteron current of 0.5×10^{-7} amp. (Gmelin Inst.)

10975 LECTURES ON THE MANY-ELECTRON PROBLEM. R. Brout and P. Carruthers. Interscience Monographs and Texts in Physics and Astronomy. Volume X. New York, Interscience Publishers, 1963. 211p. $9.50.

The linked cluster development of the many-body perturbation theory with parallel development in classical statistics, quantum adiabatic zero temperature theory, and quantum statistics and a systematic development of the many-electron problem from the plasma point of view are presented. Topics discussed include the many-body problem in classical statistical mechanics, field theory methods, electron correlation, dielectric formulation of the many-body problem, and applications to the theory of metals. (C.E.S.)

10976 INTRODUCTION TO THE VIGIER THEORY OF ELEMENTARY PARTICLES. Louis de Broglie. With a Chapter by Jean-Pierre Vigier. Translation by Arthur J. Knodel, of "Introduction à la Nouvelle Théorie des Particules." New York, Elsevier Publishing Company, 1963. 143p.

The new theory of elementary particles developed by Vigier and his coworkers is presented. The theory results in a general classification of known particles as well as in the prediction of as yet undiscovered particles. Topics discussed include the basic particles and their interactions, spin and the theory of Dirac, the general theory of particles with spin, relations between internal and external motions, and the theory of the double solution. (C.E.S.)

10977 PROPERTIES OF A SOURCE OF POLARIZED IONS AND THE DETERMINATION OF THE INTENSITY AND POLARIZATION DEGREE OF PROTONS. G. Fritsch. Thesis, Nuremberg, Universität, 1962. 28p. $2.00 (Gmelin, AED-DISS. 62-610)

The construction of an ion source and a separation magnet for the production of polarized protons and deuterons is described. A quadrupole field gives the same polarization degree and beam intensity as a six pole field. The source emits a proton current of 3.5×10^{-8} amp with a polarization degree of 48%. Methods for the measurement of beam intensities are discussed. The separation of orthohydrogen with the same apparatus using a source that was cooled with liquid nitrogen results in current of 0.8×10^{-9} amp. (Gmelin Inst.)

10978 INTERACTION OF RADIATION WITH MATTER. Roy Weinstein (Northeastern Univ., Boston). Book III of "Nuclear Engineering Fundamentals." New York, McGraw-Hill Book Company, 1964. 187p.

Gamma, charged-particle, and neutron reactions with matter are discussed. The properties of gas-filled counters and scintillation detectors are considered. Accelerators and other equipment of nuclear physics are described. Tracer techniques, biological hazards, and the uses of radiation in biology are also discussed. (C.E.S.)

Field Theory and Quantum Mechanics

10979 (HEPL-170) AN EXPERIMENT ON THE LIMITS OF QUANTUM ELECTRO-DYNAMICS. W. C. Barber, Burton Richter, W. K. H. Panofsky (Stanford Univ., Calif. Microwave Lab); G. K. O'Neill, and B. Gittelman (Princeton Univ., N. J.). June 1959. Contracts [AT(30-1)-937] and N6onr-25116. 68p.

The limitations of previously performed or suggested electrodynamic cutoff experiments are reviewed, and an electron-electron scattering experiment to be performed with storage rings to investigate further the limits of the validity of quantum electrodynamics is described. The foreseen experimental problems are discussed, and the results of the associated calculations are given. The pa-

rameters and status of the equipment are summarized. (D.C.W.)

10980 (JINR-P-1446) KOMMUTIRUYUSHCHIE TRANSLYATSIONNO-NIVARIANTNYE OPERATORNYE PALYA. (Commutating Translational-Invariant Field Operators). Kh. Ya. Khristov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 27p.

The real, commutating, and translational-invariant operators $\phi(\vec{x})$, which act in a certain configuration space H where the parameter x characterizing each of these operators is the radius-vector in the three-dimensional space E, were treated. A general form of the operators was found with only partial use of the conditions for their being non-equivalent and irreducible. (auth)

10981 (JINR-P-1459) SOOTNOSHENIE MEZHDU TOCHNYM PESHENIEM I RYADOM TEORII VOZMUSHCHENII NA PRIMERE URAVNENIYA SHREDNIGERA S SINGULYARNYM POTENTSIALOM. (On the Correlation Between the Exact Solution and the Perturbation Theory Series in the Case of the Schroedinger Equation with Singular Potential). B. A. Arbuzov, A. T. Filippov, and O. A. Khrustalev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. (Lab. of Theoretical Physics). 1963. 6p.

It is shown that the solution of Schroedinger equation with the potential $-g(\ln r)/(r^2)$ has an essential singularity in the coupling constant g for g = 0. In this case the non-applicability of the principal logarithm approximation is demonstrated. The potential used appears naturally in quantum field theory with the $\lambda\phi^4$ interaction. (auth)

10982 (JINR-P-1473) EFFEKT USILENNOI PRONITSAEMOSTI BAR'EROV DLYA SLOZHNYKH CHASTITS. (Intensified Tunnel Effect for Complex Particles). B. N. Zakhari'ev (Zakhar'ev) and S. N. Sokolov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 8p.

A quantum mechanical problem concerning the penetration of two particles in the bound state (the complex particle) through the potential barrier is treated. Accounting for the internal structure of the complex particle leads to an effective spreading of the potential barrier that facilitates the penetration through the barrier. (auth)

10983 (JINR-P-1485) O VYBORE PROPAGATOROV VEKTORNYKH POLEI. (On a Choice of Vector Field Propagators). V. I. Ogievetskii and I. V. Polubarniov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 11p.

It is shown that the vector field propagators may be taken to be transverse only in the theories where the longitudinal part of the propagators is nonessential (electrodynamics, the Yang-Mills theory for the massless vector fields, the theory of the massive neutral vector field). The choice of the propagators in the transverse form is forbidden in the local theories of massive charged vector fields since this leads to a violation of unitarity or causality principles. (auth)

10984 SOME REMARKS ON THE FOUNDATIONS OF QUANTUM MECHANICS. Nicholas Chako (City Univ. of New York). Acta Phys. Polon., 24: 629-40(Nov. 1963).

The close connection between Birkhoff's approach to quantum mechanics from the asymptotic theory of differential equations and the approach from the classical dynamical equations, based on Poincaré's fundamental theorem on the existence uniform integrals of the canonical equations and the stability condition satisfied by a dynamical system, is shown. It is shown that Birkhoff's conditions for the existence of an invariant integral of the amplitude of the asymptotic solution squared taken over a characteristic volume, defined by the classical trajectories, which expresses the quantum mechanical condition $\int\psi\psi^*d(x)$ = invariant, are the same as the conditions imposed on the solution of the variational equations that determine first order stability of the classical system. A further relation between the two methods is found to be in the similarity of the form of solution of the principal amplitude of the asymptotic expansion of the wave function and the solution of the variational equations of the coordinates and momenta of the dynamical system. Moreover, Chetaev's condition for complete stability is a special case of Birkhoff's condition for the existence of the invariant integral $\int\nu_0^2d(x)$. It is observed that both methods of approach to quantum mechanics reveal the asymptotic character of classical mechanics. (auth)

10985 ON THE QUANTUM-MECHANICAL DESCRIPTION OF NON-ISOLATED SYSTEMS. Kacper Zalewski (Inst. of Physical Chemistry, Polish Academy of Sciences, Krakow). Acta Phys. Polon., 34: 681-8(Nov. 1963).

The Schrödinger equation with a time-dependent hamiltonian is sometimes applied to the study of non-isolated systems. It is shown that this is correct (with a proper choice of the hamiltonian) if and only if the state of the system is initially pure and remains so with increasing time. Further the problem of describing a non-isolated system by the density matrix of a pure state is discussed. (auth)

10986 QUANTUM THEORY OF GRAVITATION. R. P. Feynman. Acta Phys. Polon., 24: 697-722(Dec. 1963).

The gravitational interaction of two particles expressed by means of an interchange of a virtual graviton is considered. The mathematical techniques involving gauge invariance and coordinate transformations are discussed. (C.E.S.)

10987 GRAVITATION THEORY IN THREE-DIMENSIONAL SPACE. A. Staruszkiewicz (Jagellonian Univ., Krakow). Acta Phys. Polon., 24: 735-40(Dec. 1963).

Gravitation theory in three-dimensional space (with two space-like and one time-like dimension) is considered. In particular, a general solution of the problem of motion of point particles with finite mass is proposed: the particles move along straight lines in Euclidean space, whence by cutting out certain fragments and connecting the edges of the cutting one obtains the space produced by the bodies. (auth)

10988 ON FUNCTIONAL FORMULATION OF THE S-MATRIX THEORY. Jan Rzewuski (Univ. of Wroclaw, Poland and Inst. of Physics, Polish Academy of Sciences, Wroclaw). Acta Phys. Polon., 24: 763-83(Dec. 1963).

A functional formulation of quantum field theory is presented consisting in a unification and generalization of the three- and four-dimensional functional methods. The basis for the formulation are the generating functionals for the mass shell S-matrix elements and their out of the mass shell generalizations restricted by the conditions of unitarity and causality. The notions of Hilbert space (of state vectors) and field operators in this space do not occur (at least not as primary notions) and, therefore, also the corresponding assumptions (as e.g. the asymptotic condition or the assumption about completeness) are avoided. (auth)

10989 ON THE DEFINITION OF CURRENTS AND THE ACTION PRINCIPLE IN FIELD THEORIES OF ONE SPATIAL DIMENSION. Charles M. Sommerfield (Harvard

Univ., Cambridge, Mass. and Yale Univ., New Haven). Ann. Phys. (N. Y.), 26: 1-43(Jan. 1964).

The properties of a model relativistic field theory in one space dimension are investigated. The model consists of a massless fermion field whose current is coupled to itself and also to a vector boson field with mass. By means of the action principle the effects of the coupling are simulated by functional derivatives with respect to external fields. These are carried out in closed form and yield an exact solution. It is found that the usual definition of the fermion current as the simple juxtaposition of the fermion field and its conjugate is ambiguous and does not lead to a relativistic two-vector. A more precise definition of the current, which remedies this situation, is obtained by taking the average of the limits of a nonlocal product of the fermion fields as the coordinates of those fields approach one another from a spacelike and the orthogonal timelike direction. Explicit examination of the Green's functions shows that those containing only one boson field or fermion current are consistent with the field equations, canonical commutation relations, and the definition of the current, but that this is not true for those containing two or more of these operators. This situation is clarified with the introduction of a noncovariant single-time current wherein the limit of the coordinates of the fermion fields is taken at a given time. A comparison of the matrix elements of this current with those of the covariant one shows that one of these must be considered as depending explicitly, in its definition, on the external fields. When the covariant current is so considered, the extra terms in its matrix elements coming from functional differentiation of the explicit field dependence are found to remove the inconsistency. The original use of the action principle in solving the model is re-examined and a corrected version of the Lagrange function that contains operators at one time only is derived. Because of the massless nature of the fermion field, there are expected to be both a current and a pseudocurrent that are conserved. It is found that neither of the currents (or corresponding pseudocurrents) is conserved; the actual conserved current and pseudocurrent are inferred from an examination of the matrix elements. It is then shown to what extent the action principle may be used to derive the conservation laws for them. It is also shown that three of the four components of the energy-momentum tensor may be derived directly from the Lagrange function without the knowledge of the effect of changing the direction of approach of the coordinates of the operators therein. These components are found to satisfy commutation relations that guarantee the relativistic invariance of the theory. The corrected Lagrange function was written down only after complete knowledge of the solution was at hand. The question of whether it is possible to know the Lagrange function without such knowledge is discussed. It is found that in the present case the answer is no, unless the current appearing in the field equations is defined in a manner different from the one used. A choice of the conserved current for this purpose is found to simplify some of the properties of the solution. This discussion is extended to more general models. (auth)

10990 THEORY OF RESONANCE OPTICAL ROTATION. H. F. Hameka (Univ. of Pennsylvania, Philadelphia). Ann. Phys. (N. Y.), 26: 122-30(Jan. 1964).

The theory of optical rotation was derived by means of the quantum theory of the radiation field with special emphasis on the case where the frequency of the rotated light is in the vicinity of an absorption frequency of the sample that is being studied. It is concluded that for certain frequency ranges optical rotation is not a physically meaningful concept. (auth)

10991 ON THE APPLICATION OF THE METHOD OF GREEN FUNCTIONS TO SOME PROBLEMS IN QUANTUM STATISTICAL MECHANICS. Rolf Dobbertin. Cahiers Phys., 17: 81-6(Feb. 1963). (In French)

The Green functions method for calculations on particle interactions is outlined. The calculation of the thermodynamic potential, energy spectrum, and other quantities for an equilibrium system of bosons and fermions is considered, together with the calculation of the thermodynamic potential of correlation, the plasma frequency, and dispersion relations for a plasma. (D.C.W.)

10992 THE INTEGRAL EQUATION FOR THE APERTURE FIELD WITH ELECTROMAGNETIC COUPLING OF TWO VOLUMES. I. B. Levinson, S. S. Fel, and P. Sh. Fridberg. Dokl. Akad. Nauk SSSR, 153: 310-12(Nov. 11, 1963). (In Russian)

If the electromagnetic waves in each of two volumes bounded by conducting walls are described by dyadic Green's functions, the coupling of these fields through an aperture in the common surface between these two volumes can be described in terms of the Green's functions and the electric field in the aperture $\vec{E}_a$, which can be found from the integral equation $\int d\vec{s}' N(\vec{r},\vec{r}') \cdot \vec{E}_a(\vec{r}') = \vec{K}(\vec{r})$, where N is a dyad that depends on the Green's functions and the admittances of the two media, $\vec{K}$ is the sum of the tangential components of the unperturbed magnetic fields in the two volumes at the aperture, and $d\vec{s}'$ and $\vec{r}'$ refer to the aperture. The method can be applied to the electromagnetic coupling at the junction of a wave guide and a resonator. No limitations are placed on the geometry of the system or on the dimensions of the coupling. (TTT)

10993 "LINEARIZATION" OF NONLINEAR EQUATIONS FOR SPINOR FIELDS BY "FUSING" FERMIONS INTO BOSONS. Yu. I. Gubar (All Union Mechanical Inst. by Correspondence, USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 5, 140-6(1963). (In Russian)

Generalized spinor field equations transform into linear Fermi-field equations when fermions are fused into bosons. Studies were made of cubic equations with normalization to arbitrary nonlinearity. Linearized spinor field equations correspond to the Green function equivalence for nonlinear and ordinary theory. Various fermion fusions are analyzed, and sources of nonlinearity are discussed. (tr-auth)

10994 ON THE USE OF THE WBK METHOD FOR OBTAINING ENERGY EIGENVALUES. Charles L. Beckel, Jamil Nakhleh, and Yalamanchili R. Chowdary (Georgetown Univ., Washington, D. C.). J. Chem. Phys., 40: 139-45 (Jan. 1, 1964).

A general method is proposed for evaluation of the second-order WBK energy integral. The domain of the potential is extended into the complex plane by expansion in Taylor's series about the classical turning points. The method is illustrated by application to the one-dimensional harmonic oscillator for which the second-order integral is exactly zero. Application is also made to a typical molecular potential, the Heitler-London potential for H_2. In the latter problem exact eigenenergies, accurate to about 0.2 cm^{-1}, are obtained by a Runge-Kutta integration of the Schrödinger equation. These are compared with first-order WBK energies obtained with and without use of the Langer-Kemble radial correction, and with second-

order WBK energies obtained with and without use of the Langer-Kemble correction. The uncorrected first-order WBK energies are accurate to within 2 cm^{-1} and the first differences to within 0.6 cm^{-1}. Uncorrected second-order WBK energies agree with the Runge-Kutta values and, in fact, are probably more accurate than the latter. The first-order Langer-Kemble corrected energies are up to 9 cm^{-1} in error; corrected first differences, however, are more accurate than uncorrected values at low quantum numbers. The poorest set of energies and first differences are the corrected second-order values, indicating that the Langer-Kemble correction is not applicable when the second-order WBK approximation is employed. Computing time requirements and advantages of the WBK and Runge-Kutta methods are briefly discussed. (auth)

10995 OFF-DIAGONAL HYPERVIRIAL THEOREM AND ITS APPLICATIONS. Joseph C. Y. Chen (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 40: 615-21(Feb. 1, 1964). (BNL-7363)

A hypervirial operator, by definition, is a time-independent linear operator with an arbitrary functional structure expressed in terms of the dynamical variables of the system under consideration. In the energy representation, the diagonal matrix elements of the hypervirial operator are constant in time; this is known as the hypervirial theorem. The off-diagonal matrix elements of the hypervirial operator in the energy representation oscillate in time with frequencies related to the energy differences between their corresponding stationary states of the system. This is known as the off-diagonal hypervirial theorem. The latter theorem is as powerful as the former for dealing with many quantum-mechanical problems. Several aspects of the possible applications of the theorem to the problem of construction and improvement of wavefunctions are considered. As a special example, the restricted fourth alternative expression for dipole transition matrix elements is derived for pair functions not belonging to states with zero orbital angular momentum. A scheme is also outlined for improving wavefunctions of the excited states. The statistical implications of the sum rule, which is expressed in terms of an appropriate hypervirial operator, are discussed in connection with uncertainty principles. (auth)

10996 ON THE EXPRESSIONS OF CLEBSCH-GORDAN COEFFICIENTS. T. Shimpuku (Shiga Prefectural Junior Coll., Japan). J. Math. Anal. and Appls., 7: 397-419(Dec. 1963).

The Clebsch-Gordan coefficients are defined, and fundamental identities in binomial coefficients, identical transformations, Regge's symmetry relations, fractional expressions of a summation part, and expressions of the Clebsch-Gordan coefficients are discussed. (C.E.S.)

10997 GROUP-THEORETICAL MODELS OF LOCAL-FIELD THEORIES. Hans Joos (Inst. for Advanced Study, Princeton, N. J.). J. Math. Phys. (N. Y.), 5: 155-64(Feb. 1964).

Local fields on a finite, discrete, space-time model are introduced as a guide for axiomatic discussion of quantum field theory. (auth)

10998 ASYMPTOTIC PROPERTIES OF THE ELECTROMAGNETIC FIELD. J. N. Goldberg and R. P. Kerr (Aerospace Research Labs., Wright-Patterson Air Force Base, Ohio). J. Math. Phys. (N. Y.), 5: 172-6(Feb. 1964).

From the integral form of the general solution for the retarded electromagnetic field of a localized charge-current distribution, the asymptotic field is shown to have the behavior $F_{\mu\nu} = N_{\mu\nu}/R + III_{\mu\nu}/R^2 + {}_2J_{\mu\nu}/R^3$, where the coefficients satisfy $N_{\mu\nu}k^\nu = 0$, $III_{\mu\nu}k^\nu = Ak_\mu$, and $k_\mu k^\nu = 0$. The remainder ${}_2J_{\mu\nu}$ is shown to be bounded by using the second-mean-value theorem. Thus the algebraically special character of the asymptotic electromagnetic field is exhibited. (auth)

10999 CONTINUOUS-REPRESENTATION THEORY. III. ON FUNCTIONAL QUANTIZATION OF CLASSICAL SYSTEMS. John R. Klauder (Bell Telephone Labs., Murray Hill, N. J.). J. Math. Phys. (N. Y.), 5: 177-87 (Feb. 1964).

The form of Schroedinger's equation in a continuous representation is indicated for general systems and analyzed in detail for elementary Bose and Fermi systems, for which illustrative solutions are given. For any system, a natural continuous representation exists in which state vectors are expressed as continuous, bounded functions of the corresponding classical variables. The natural continuous representation is generated by a suitable set S of unit vectors labeled by classical variables for which, for the system in question, the quantum action functional restricted to the domain S is equivalent to the classical action. When a classical action is viewed in this manner it contains considerable information about the quantum system. Augmenting the classical action with some physical significance of its variables it is proved that the classical theory virtually determines the quantum theory for the Bose system, while it uniquely determines the quantum theory for the Fermi system. (auth)

11000 ACCURACY OF THE SEMICIRCLE APPROXIMATION FOR THE DENSITY OF EIGENVALUES OF RANDOM MATRICES. Burt V. Bronk (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 5: 215-20(Feb. 1964).

Certain statistical properties of the energy levels of complex physical systems were found to coincide with those for distributions of eigenvalues derived from ensembles of random matrices. However, if ensembles of random matrices give a fair representation for the Hamiltonian of a complex physical system, the density of the characteristic values at the lower end of the spectrum should show some similarity with the exponential dependence found in nuclear spectra. The limiting distribution of the density for very high-dimensional random matrices is a semicircle, i.e., concave from below if plotted against the characteristic value that represents, in this case, the energy. Hence the deviations from the limiting distribution are investigated and it is shown that there is a region, at the very lowest part of the spectrum, where the density is convex from below, similar to an exponential function. The region of convexity is called the tail of the distribution. It is shown, however, that the average number of roots in the tail is very small, of the order of 1. It is concluded that those ensembles of random matrices that were studied up to now, do not give a fair representation of Hamiltonians of complex systems. (auth)

11001 STROBOSCOPIC-PERTURBATION PROCEDURE FOR TREATING A CLASS OF NONLINEAR WAVE EQUATIONS. Martin D. Kruskal (Princeton Univ., N. J.) and Norman J. Zabusky. J. Math. Phys. (N.Y.), 5: 231-44(Feb. 1964).

A new perturbation procedure is presented for treating initial-value problems of nonlinear hyperbolic partial differential equations. The characteristic variables of the partial differential equation and the functions of these variables are expanded in powers of ϵ, and the formal solution is uniformly valid over time intervals $O(1/\epsilon)$.

The uniform first-order solution is evaluated for the equation $y_{tt} = (1 + \epsilon y_x)y_{xx}$, subject to the standing-wave initial conditions: $y(x,0) = a \sin \pi x$, $y_t(x,0) = 0$. This equation is the lowest continuum limit of an equation for which numerical computations are available. The uniform zero-order solution breaks down after a time $t_B = 4/\epsilon a\pi$. A detailed study of the solution is made in the vicinity of the breakdown region of the (x,t) plane, and it demonstrates that the formal solution for y_x and y_t goes from a single-valued to a triple-valued function while y_{xx} and y_{tt} become singular. To compare the solutions with the available numerical computations, the y_x and y_t waveforms are decomposed into spatial Fourier modes. The effect of breakdown is manifest in the modal amplitudes $\propto J_n(nT)/nT$. The modal amplitudes change their asymptotic behavior, from exponentially decreasing as $n \to \infty$, to algebraically decreasing when t goes from smaller to larger than t_B. In the time interval up to breakdown, $t < t_B$, the modal energies are in excellent agreement with the modal energies of the numerical computations, whereas for $t > t_B$ they diverge. For $t < t_B$, the total energy calculated from the uniform zero-order solution is conserved and equal to the initial value, $E_C^{(0)} = 2a^2\pi^2 \sum_{n=1}^{\infty} \{[J_n(nT)]/[(nT)]\}^2 = \frac{1}{2}a^2\pi^2 = E_C|_{t=0}$, $t \leq t_B$. Thus, the lowest-continuum-limit equations describe the dynamics of a discrete model for a finite time. A heuristic discussion is given that suggests that the time of description can be extended beyond t_B by including higher spatial derivatives in the continuum model. (auth)

11002 EXPLICIT FORMAL CONSTRUCTION OF NONLINEAR QUANTUM FIELDS. I. E. Segal (Massachusetts Inst. of Tech., Cambridge). J. Math. Phys. (N. Y.), 5: 269-82(Feb. 1964).

It is shown that there can be associated with any given nonlinear relativistic partial differential equation an operator field satisfying the canonical commutation relations, transforming appropriately under the action of the Lorentz group, and propagated in accordance with the given differential equation. This quantization procedure is unique, apart from the scale of the commutators. The treatment is intuitive, but is capable of rigorization in terms of the mathematical theory of analysis in function space. The results are in harmony with crucial conventional ones, so far as is determined, and provide in principle a possible means of computing the collision matrix for particular systems without recourse to perturbation theory. (auth)

11003 IRREDUCIBLE TENSOR EXPANSION OF SOLID SPHERICAL HARMONIC-TYPE OPERATORS IN QUANTUM MECHANICS. Ying-nan Chiu (Univ. of Chicago). J. Math. Phys. (N. Y.), 5: 283-8(Feb. 1964).

A method is proposed to derive the general one- and two-center expansions of quantum mechanical operators that are in the form of regular or irregular solid spherical harmonics of any integral degree. The expansions are expressed as couplings of irreducible spherical tensors. The physical nature of such coupling and the parallelism to vector addition are illustrated. Possible uses of such expansions in the evaluation of molecular integral and their reduction to simple, known expansions obtained from other methods are briefly discussed. (auth)

11004 THE REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP IN TERMS OF AN ANGULAR MOMENTUM BASIS. J. S. Lomont (Polytechnic Inst. of Brooklyn, N. Y.) and H. E. Moses. J. Math. Phys. (N. Y.), 5: 294-?(Feb. 1964).

The irreducible ray representations of the proper, orthochronous, inhomogeneous Lorentz group were originally given by Wigner in terms of a basis in which the energy and linear momenta are diagonal. It is shown how the infinitesimal generators of the irreducible representations act on a basis in which the energy, the square of the angular momentum, the component of the angular momentum along the z axis, and the helicity (or circular polarization) are diagonal. Representations corresponding to particles of nonzero mass and any spin, and of zero mass and finite spin are considered. (auth)

11005 ANALYTICITY IN THE ANGULAR MOMENTUM IN POTENTIAL SCATTERING. V. De Alfaro, E. Predazzi and C. Rossetti (Università Turin and Instituto Nazionale di Fisica Nucleare, Turin). Nuovo Cimento (10), 31: 42-55(Jan. 1, 1964).

A representation is given in the framework of potential scattering for $\varphi(\lambda,k,x)$ and for the Jost function displaying their analytic properties in the angular momentum variable under suitable conditions on the behavior of the interaction at small distances. A perturbative form for the Regge trajectories is also given. The Jost function is obtained as an expansion over meromorphic functions of the angular momentum variable. (auth)

11006 SOME REMARKS ON THE RELATIVISTIC WAVE EQUATIONS. A. Galindo and P. Pascual (Junta de Energia Nuclear, Madrid). Nuovo Cimento (10), 31: 132-9(Jan. 1, 1964).

A general method is given to construct realizations of relativistic elementary particles. It is shown that the Dirac-Fierz-Pauli equations are simply the functional expressions of the equivalence mappings relating some of these realizations. The introduction of the electromagnetic interaction is analyzed; the usual method leads to compatible algebraic operations even for spin-1 particles. The mathematical and physical difficulties inherent to that procedure can be avoided by means of a natural generalization of the two-component electron theory of Feynman and Gell-Mann. (auth)

11007 FINITE-PART INTEGRALS: A GENERALIZATION OF HADAMARD'S DEFINITION. B. Preziosi (Università, Naples and Istituto Nazionale di Fisica Nucleare, Naples). Nuovo Cimento (10), 31: 187-202(Jan. 1, 1964).

A generalization of Hadamard's finite-part integrals is presented, such as was proved desirable in previous work for the evaluation of renormalized quantities in field theory without use of counter-terms. In particular, the legitimacy of the interchange of limiting and/or integration processes is demonstrated, provided a consistent use of pseudofunctions is made. Some special prescriptions are discussed in detail and examples are given. (auth)

11008 A NOTE ON THE DE ALFARO, REGGE AND ROSSETTI DYNAMICAL EQUATION FOR JOST FUNCTIONS. M. Petráš (Univerzity Komenského, Bratislava). Nuovo Cimento (10), 31: 247-9(Jan. 1, 1964).

A variation of the derivation of the dynamical equation for Jost functions in the case of superposition of Yukawa potentials is given using the analytic properties of the scattering amplitude. (R.E.U.)

11009 ON THE UNCERTAINTY RELATION FOR ANGLE VARIABLES. D. Judge (University Coll., Dublin). Nuovo Cimento (10), 31: 332-40(Jan. 16, 1964).

The uncertainty relation between the orbital angular momentum component L_z and the corresponding angle φ is discussed. The uncertainty for an angle variable is defined. The formula $\Delta L_z \cdot \Delta\varphi \geq \frac{1}{2}h$, which is sometimes quoted, is shown to be incorrect, and an alternative rela-

tion, in full accord with the Heisenberg Uncertainty Principle, is derived. (auth)

11010 BOHR-SOMMERFELD'S QUANTUM CONDITIONS AND RIGID BODY ROTATION. T. Gotō (Università, Naples). Nuovo Cimento (10), 31: 397-401(Jan. 16, 1964).

Rotational motions of a spherically symmetric rigid body are studied in the frame of old quantum theory. It is shown that half-integral spin states come into play in this semiclassical step and all possible quantum states are exactly the same as those given by the representation theory of the three-dimensional rotation group. (auth)

11011 THE DISPOSITION OF AN IONIZED GAS IN A GRAVITATIONAL FIELD. J. E Allen (EURATOM-CNEN, Frascati, Italy); S. E. Segre, and A. Turrin. Nuovo Cimento (10), 31: 402-13(Jan. 16, 1964).

Calculations are given of the density distributions of electrons and ions in thermodynamic equilibrium in the presence of a uniform gravitational field. Charge separation occurs and the resulting electrostatic potential was calculated. (auth)

11012 BOSE FIELDS AND INEQUIVALENT REPRESENTATIONS. S. Kamefuchi and H. Umezawa (Inst. of Mathematical Sciences, Madras). Nuovo Cimento (10), 31: 429-46(Jan. 16, 1964).

The self-consistent method based on the inequivalent representations, which was developed for fermion fields is extended to boson fields. An application is also made to the Goldstone models. The results seem to indicate that the Goldstone theorem does not always hold true in theories that make use of the self-consistent method. (auth)

11013 NOISE CONSIDERATIONS IN GRAVITATIONAL EXPERIMENTS. J. Weber (Univ. of Maryland, College Park). Nuovo Cimento (10), 31: 462-4(Jan. 16, 1964).

The noise considerations and power requirements of proposed experiments for detection of the emission of gravitational radiation by the change in power of a driving source are discussed. (C.E.S.)

11014 PURE MAGNETIC AND ELECTRIC GEONS. M. A. Melvin (Florida State Univ., Tallahassee). Phys. Letters, 8: 65-8(Jan. 1, 1964).

A rigorous, static, cylindrically symmetrical solution of the combined sourceless Einstein-Maxwell system showing the persistent local energy-stress concentration that can be taken as the defining characteristic of a geon was obtained. The solution represents a parallel bundle of electric or magnetic flux held together by its own gravitational pull. (auth)

11015 A SOLVABLE MODEL OF AN INTERACTING RELATIVISTIC FIELD. J. T. Łopuszański (Univ. of Wrocław, Poland). Phys. Letters, 8: 85-7(Jan. 1, 1964).

A model of a real, scalar, relativistic field is investigated. (D.C.W.)

11016 TEST OF SPECIAL RELATIVITY OR OF THE ISOTROPY OF SPACE BY USE OF INFRARED MASERS. T. S. Jaseja, A. Javan, J. Murray, and C. H. Townes (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 133: A1221-5(Mar. 2, 1964).

The highly monochromatic frequencies of optical or infrared masers allow very sensitive detection of any change in the round-trip optical distance between two reflecting surfaces. Hence, comparison of the frequencies of two masers with axes perpendicular to each other allows an improved experiment of the Michelson-Morley type, or a very precise examination of the isotropy of space with respect to light propagation. Two He–Ne masers were mounted with axes perpendicular on a rotating table carefully isolated from acoustical vibrations. Their frequency difference was found to be constant to within 30 c over times as short as about one second, or to one part in 10^{13} of the maser frequency, which is near 3×10^{14} c. Rotation of the table through 90° produced repeatable variations in the frequency difference of about 275 kc presumably because of magnetostriction in the Invar spacers due to the geomagnetic field. Examination of this variation over six consecutive hours shows that there was no relative variation in the maser frequencies associated with orientation of the earth in space greater than about 3 kc. Hence there is no anisotropy or effect of either drift larger than 1/1000 of the small fractional term $(v/c)^2$ associated with the earth's orbital velocity. This preliminary version of the experiment is more precise by a factor of about three than previous Michelson-Morley experiments. There is reason to hope that improved versions will allow as much as two more orders of magnitude in precision, and that similar techniques will also yield considerably improved precision in an experiment of the Kennedy-Thorndike type. (auth)

11017 DYNAMICAL DECOMPOSITION OF A LARGE SYSTEM. J. Korringa (Université, Besançon, France). Phys. Rev., 133: A1228-9(Mar. 2, 1964).

The equations for the statistical matrix ρ_0 and the correlation matrix $\rho_0(t_1,t_2)$ of a large system subject to time-dependent external forces are case in a new form based on a continuation of Schrödinger's equation to complex times. It is shown that these equations also apply when the time dependence of the hamiltonian is due to a coupling with another system (heat bath) which is at equilibrium at a temperature θ', but that such time dependence must be expressed in terms of random functions of the complex argument $z' = t - i/2\theta'$. A generalization to the case that the external time-dependent fields and the coupling with a heat bath exist simultaneously is straightforward and leads to a Schrödinger-type equation with non-Hermitian hamiltonian that describes the dynamical and statistical aspects of the motion. (auth)

11018 OCCUPATION NUMBER REPRESENTATION WITH LOCALIZED ONE PARTICLE FUNCTIONS. (MACROSCOPIC DESCRIPTION OF QUANTUM GASES 1). Siegfried Grossmann (Freie Universität, Berlin). Physica, 29: 1373-92(Dec. 1963).

The understanding of macroscopic-stochastic and macroscopic-deterministic properties of quantum gases is considered. Localized one-particle functions (localized in configuration space and momentum space) are used to define particle number operators, whose expectation values are the Boltzmann distribution function of the gas if measured in suitable macroscopic ensembles. In order to discuss its time development, the hamiltonian of the gas is translated into the occupation number representation with the localized wave functions. This results in a change of the distribution function due to streaming and collisions, and in typical microscopic quantum effects. The general concept of macroscopic observables is discussed. (auth)

11019 DYNAMIC GYROMAGNETIC EFFECTS. S. P. Heims (Brandeis Univ., Waltham, Mass.). Physica, 29: 1430-40(Dec. 1963).

Time-dependent linear gyromagnetic effects are treated in terms of Kubo's theory of irreversible processes. Quantitative and qualitative relations between various pos-

sible experiments are pointed out. The time constants give information about relative relaxation rates of spin and orbital angular momentum. If the hyperfine interaction is strong, the Einstein-de Haas effect may give information on electron-nuclear spin correlations; also nuclear polarization by rotation analogous to Rose-Gorter polarization is expected to be possible. A small inertial line shift due to rotation is noted. (auth)

11020 SOLUTIONS OF GAUGE-INVARIANT GENERALIZATION EQUATIONS OF FIELD THEORIES WITH ASYMMETRIC FUNDAMENTAL TENSOR. R. S. Mishra. Quart. J. Math. (Oxford) (2), 14: 81-5(June 1963).

Buchdahl gave Gauss-invariant equations of unified field theories and solved them by the method of approximation. An outright tensorial solution of one of his equations is given, and it is shown that Buchdahl's solution can be obtained as a particular case. (auth)

11021 DOUBLE LOGARITHMIC APPROXIMATION IN QUANTUM ELECTRODYNAMICS. G. A. Milekhin and E. S. Fradkin (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 45: 1926-39(Dec. 1963). (In Russian)

A perturbation theory in number of hard quanta is developed within the framework of the continual integration method. The contribution of soft photons responsible for the appearance of double logarithmic terms is taken into account exactly in all orders in e^2. The method is employed for calculation of various cross sections for high particle interaction in which soft photon radiation is taken into account. (auth)

11022 CONTRIBUTION TO FIELD THEORY WITH NONLOCAL INTERACTION. III. DIAGRAM TECHNIQUE. D. A. Kirzhnits (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 45: 2024-37(Dec. 1963). (In Russian)

Rules for construction of the matrix elements in nonlocal field theory are formulated. The rules differ from the usual ones in that a form factor is included in the vertex part of the diagram, an obligatory condition being that in evaluating the integrals by the residue method the form factor singularities should not be taken into account. Analytical properties of the matrix elements are investigated, and the appearance of specific singularities whose position does not depend on the elementary length is noted. It is pointed out that the Green functions constructed from Heisenberg and in-operators of the field are not identical. This leads to appearance of complex singularities in the self energy part. The validity of the Lehmann—Symanzik—Zimmermann reduction formula for scattering matrix elements in nonlocal field theory is elucidated. (auth)

11023 EXTRA-NEWTONIAN EQUATIONS OF MOTION AND THE HARMONICITY CONDITIONS. G. Voevoda (Vrotslav Polytechnic Inst., USSR). Zh. Eksperim. i Teor. Fiz., 45: 2051-63(Dec. 1963). (In Russian)

The relation between the harmonicity conditions and equations of motion in Einstein's theory of gravitation is investigated. Following Infeld, material bodies are regarded as field singularities characterized by the Dirac δ-functions. It is assumed that the metric tensor can be represented as a power series in c^{-1}. It is also assumed that the derivatives with respect to x^0 are of the order of c^{-1} relative to derivatives in t. It is proved that under these assumptions for deduction of extra-Newtonian equations from the gravitational field equations, harmonicity equations of the zero, first, and second orders are necessary and sufficient. (auth)

11024 GROUP THEORY. THE APPLICATION TO QUANTUM MECHANICS. Paul H. E. Meijer and Edmond Bauer. Amsterdam, North-Holland Publishing Company, 1962. 299p.

The application of group theory to eigenvalue problems is discussed, where the differential equation or the boundary are of such a geometric nature that certain rotations or translations leave the problem unchanged. For this case there may be more than one eigenfunction belonging to the same eigenvalue, and transformation properties of the eigenfunctions may be used to study the eigenvalue problem. Representation theory is developed on the basis of Schur's Lemma. Similarity transformation is described as a rotation in multidimensional function space and the reduction is described in terms of mutual orthogonal spaces. Subjects included are unitary geometry in vector spaces, some principles of quantum mechanics, group theory and some applications to quantum mechanics, e.g., Wigner's theorem, rotations in three-dimensional space, space groups, and finite groups. 69 references. (R.E.U.)

11025 FORMAL STRUCTURE OF ELECTROMAGNETICS. GENERAL COVARIANCE AND ELECTROMAGNETICS. E. J. Post. From the Series in Physics. Amsterdam, North-Holland Publishing Company, 1962. 216p. $7.50.

An explicit treatment of the principle of general covariance as applied to electromagnetics is presented. The customary close association between general covariance and relativity is de-emphasized. Topics discussed include transformation behavior and dimensional properties of physical fields, natural invariance of the Maxwell equations, variational aspects, lagrangians, general properties of the medium, nonuniformity, anisotropy, and general coordinates in three-space, reciprocity and nonreciprocity, and matter-free space with a gravitational field. (C.E.S.)

Geophysics

Refer also to abstract 11333.

11026 (BRL-1187) SUMMARY REPORT ON STRONG-ARM ROCKET MEASUREMENTS OF ELECTRON DENSITY TO AN ALTITUDE OF 1500 KILOMETERS. Spence T. Marks, Charles E. Shafer, William J. Cruickshank, Raymond E. Prenatt, and George A. Dulk (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Jan. 1963. 110p. (AD-404189)

An experiment for measuring the electron density to an altitude of 1500 kilometers by using a five-stage solid propellant rocket combination is summarized, together with a two-frequency propagation experiment. The theory applicable to the measurements, the rocket vehicle, the airborne instrumentation, the ground instrumentation, the vehicle performance, and the experimental results are described. An early morning electron density profile to an altitude of 1500 kilometers is presented, together with a daytime and a nighttime profile to 650 kilometers. A model of the ionospheric inhomogeneities that existed during the daytime rocket flight is given. Scale heights and exospheric temperatures derived from the profiles are also presented and discussed. (auth)

11027 (LNF-63/54(p.27)) EFFETTO DIURNO NELLA FASCIA INTERNA DI VAN ALLEN. (Diurnal Effect in the Inner Van Allen Belt). L. Mancino, G. Pizzella (Rome. Università. Istituto di Fisica); and F. Molina (Rome. Università. Istituto di Geofisica).

Measurements made with a Geiger counter on Explorer

VII from October 13, 1959, to December 31, 1960, at an altitude between 600 and 1100 km are analyzed. The results show a dependence of the intensity of the inner Van Allen belt on the local time with the maximum at 600 hours and the minimum at 1800 hours. Such a reaction is generated by the earth–sun interaction and is probably due to distortion of the terrestrial magnetic field produced by solar winds. (J.S.R.)

11028 (TID-20111) ON THE ENERGY CYCLE IN THE LOWER STRATOSPHERE. Report No. 9. Abraham H. Oort (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). Dec. 15, 1963. Contracts AT(30-1)-2241 and AF19(604)-5223. 129p.

The circulation in the lower stratosphere was studied for the period July 1957 through June 1958 during the IGY. Radiosonde reports from more than 240 northern hemisphere stations were used. In all seasons the large-scale eddies transport both heat and momentum against the north-south gradient of, respectively, the temperature and angular rotation. Warm air masses tend to move towards higher pressure (sink) and cold air masses towards lower pressure (rise). That is, no kinetic energy is released by convection. For a hemispheric polar cap with 30 and 100 mb as top and bottom boundaries the balance equations of angular momentum, zonal and eddy kinetic energy, and zonal and eddy available potential energy are considered in detail. The eddies appear to build up the kinetic energy of the zonal flow at the expense of the eddy kinetic energy throughout the year. The eddies lose also eddy potential energy to the mean zonal distribution, in agreement with the abnormal upslope direction of the eddy heat transport. Thus, no source of energy for the eddy motions appears to be present in situ; and the eddies are forced by the circulation in the surrounding layers, probably by the tropospheric motions. (auth)

11029 (AEC-tr-6128(p.52-78)) THE USE OF RADIOACTIVE CARBON IN GEOPHYSICAL RESEARCH. G. S. Kirdin. (Translation)

A survey is presented of the uses of C^{14} in studies of the exchange of carbon between the geospheres (circulation of carbon in nature). The studies include carbon exchange between atmosphere and ocean, circulation of carbon in atmosphere, carbon exchange between hemispheres, and natural sciences (soils, limnology, and oceanography). The formation of C^{14} in nature by natural processes and nuclear explosions is considered briefly. (D.L.C.)

11030 GENERAL CHARACTERISTICS OF pc-TYPE PULSATIONS. R. W. E. McNicol and J. S. Mainstone. (Univ. of Queensland, Australia). Australian J. Phys., 16: 507-13(Dec. 1963).

An analysis of geomagnetic micropulsations of the pc type, i.e. continuous pulsations detectable for several hours at a time, recorded from May to October 1962 showed that the frequency spectrum was usually spread over several octaves even when the waveform shown on the chart records was quasi-sinusoidal. The greatest spread was around midday, being from about 0.02 to 0.08 c on days of mild magnetic activity ($K_p = 3$). Generally pc occurred most strongly between about 0600 and 2000 L.M.T., but on occasions was recorded throughout the whole 24 hours. A striking feature was the sudden change in activity that frequently took place within an interval of a few minutes. Good correlation was obtained between both the amplitude and the highest frequency in the pc spectrum, and K_p. (auth)

11031 DISTRIBUTION OF AURORAS IN THE SOUTHERN HEMISPHERE. III. COMPARISON WITH NORTHERN HEMISPHERE. F. R. Bond and F. Jacka (Dept. of External Affairs, Melbourne). Australian J. Phys., 16: 514-19(Dec. 1963).

While the distribution of auroras in the southern hemisphere is well represented in terms of each of the parameters θ_1, θ_2, and θ_3, the northern hemisphere distribution is not satisfactorily represented in terms of θ_1. In terms of θ_2 or θ_3, and within the limits of accuracy of the data, the distributions in the two hemispheres are conjugate. To carry this investigation further, much more accurate data and more refined concepts are required. (auth)

11032 THE DIRECTIONS OF AURORAL RAYS. II. METHODS OF DETERMINATION. K. D. Cole (Dept. of External Affairs, Melbourne). Australian J. Phys., 16: 520-5(Dec. 1963).

Two simple methods are described for finding accurately the direction of an auroral ray from a parallactic pair of photographs. Errors are discussed. The methods reopen an experimental field, namely, the study of the relation of the direction of the geomagnetic field in the polar ionosphere to that at the ground. (auth)

11033 SWEPT-FREQUENCY RADIO OBSERVATIONS AT THE TIME OF THE NUCLEAR EXPLOSION OVER JOHNSTON ISLAND ON JULY 9, 1962. K. V. Sheridan and J. Joisce (Commonwealth Scientific and Industrial Research Organization, Chippendale, New South Wales). Australian J. Phys., 16: 584-5(Dec. 1963).

The sudden ionospheric disturbance that occurred at the moment of detonation of the high-altitude explosion over Johnston Island was recorded with a 5-210 Mc radiospectrograph. The fadeouts caused by the explosion were compared with solar-induced fadeouts. (C.E.S.)

11034 EFFECT OF MAGNETIC ANOMALIES ON VERY LOW FREQUENCY DISCRETE EMISSIONS. R. L. Dowden (Univ. of Tasmania, Hobart, Australia). Australian J. Phys., 16: 588-92(Dec. 1963).

The previously proposed idea that the spectrogram shapes of v-l-f discrete emissions can be explained as Doppler-shifted cyclotron radiation from electrons spiralling along a geomagnetic field line is discussed. In this case the variation of frequency is produced entirely by the variation of magnetic field along the path. (C.E.S.)

11035 THE INTERACTION BETWEEN WEAK CORPUSCULAR STREAMS AND THE UPPER ATMOSPHERE. M. S. Kovner and V. Yu. Trakhtengerts (Gorkii State Univ., USSR). Geomagnetism Aeronomy, 2: 871-6(1962).

Problems related to the generation of ultra-low-frequency radiation in the earth's upper atmosphere by solar corpuscular streams are considered. The hypothesis that electromagnetic waves are excited at frequencies close to $\omega_H \cos\alpha$, makes it possible to explain qualitatively a number of observed spectral characteristics. The determined values of the optical thickness and the amplification factor make it possible to estimate the velocities and concentrations of the streams necessary for exciting the ultra-low-frequency radiation. (auth)

11036 THE STEADY STATE OF CORPUSCULAR STREAMS CORRESPONDING TO THE MOST COMMON AURORAL FORMS. V. I. Pogorelov (Inst. of Physics of the Atmosphere, Academy of Sciences, USSR). Geomagnetism Aeronomy, 2: 890-3(1962).

It is shown that of all the forms of streams responsible for auroral luminosity, only in cylindrically symmetric and linear streams is the steady state not related to the satis-

faction of any relationships between field strengths and the parameters of the medium at any point in the stream. (auth)

11037 SHORT-PERIOD VARIATIONS OF THE INTENSITY OF AURORAL LUMINOSITY. R. G. Skrynnikov (Leningrad State Univ.). Geomagnetism Aeronomy, 2: 894-6 (1962).

Short-period variations of auroral luminosity were recorded at Lozovero station in 1961 to 1962 using a 180° photometer with a flat photocathode. In all auroral forms there were variations whose development and periods were similar to SIP variations of the magnetic field. The spectrum of these variations and their distribution by time of day are described. In some auroral forms there are brightness variations of other types, called bursts and bays. The periods and amplitudes of these types of variations are given, as well as the auroral forms in which they are encountered. (auth)

11038 ANOMALOUS ABSORPTION IN THE POLAR CAP. G. M. Khocholava (Inst. of Geophysics, Academy of Sciences, Georgian SSR). Geomagnetism Aeronomy, 2: 907-13(1962).

Problems related to the study of anomalous absorption in the polar cap (additional ionization in the ionosphere, density of the stream of fast particles, and dynamics of the region of anomalous absorption before and after a SC geomagnetic storm). It is shown that the additional electron concentration is 10^4 to 10^5 cm^{-3}, and the density of the stream of fast particles is 10^{-8} to 10^{-10} cm^{-3}. Different types of relations between anomalous absorption in the polar cap and a SC geomagnetic storm are pointed out. An explanation is given for the difference between the theoretically predicted and experimentally derived displacement of the outer boundary of anomalous absorption at the time of the main phase of a storm. (auth)

11039 DIURNAL VARIATION IN THE PROBABILITY OF THE OCCURRENCE OF COMMENCEMENTS, ACTIVE PERIODS AND ENDS OF MAGNETIC STORMS. V. M. Mishin, N. Ya. Naydenova, and M. L. Platonov (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 2: 917-21(1962).

The probability of commencements and ends of geomagnetic storms shows a sharp dependence on time of day. This dependence is a simple consequence of S_a. The streams responsible for g storms have a compressed front. (auth)

11040 COMPARISON OF MAGNETIC DISTURBANCE IN THE HIGH LATITUDES AND THE STÖRMER THEORY. A. P. Nikol'skii (Arctic and Antarctic Scientific Research Inst., USSR). Geomagnetism Aeronomy, 2: 930-3(1962).

The data for magnetic disturbance at the Cape Chelyuskin, NP-4, and NP-6 stations were analyzed. It is shown that the mean duration of the period of high values of magnetic disturbance is from 6 to 8 hours. The relative increase and decline of magnetic disturbance at these stations occurs in conformity to change of the angle ψ, defined as the angle between the direction to the radiation source and the geomagnetic equator. (auth)

11041 ELECTROMAGNETIC OSCILLATIONS IN THE GEOMAGNETIC CAVITY. M. A. Gintsburg (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 2: 949(1962).

Electromagnetic oscillations in the cavity produced where the earth's magnetosphere cuts into a solar corpuscular stream are discussed. (R.E.U.)

11042 PERIODIC CHANGES OF AURORAL LIGHT FLUX. Yu. A. Nadubovich and I. A. Rudenko (Geophysical Observatory, Academy of Sciences, Siberian SSR). Geomagnetism Aeronomy, 2: 953-5(1962).

An analysis was made of photometer measurements to determine the periodicity in the development of auroras. (R.E.U.)

11043 MIDDLE-LATITUDE Lpc DURING GEOMAGNETIC STORMS. I. I. Rokityanskii (Inst. of Physics of the Earth, Geophysical Station "Borok", Academy of Sciences, USSR). Geomagnetism Aeronomy, 2: 957-8 (1962).

Long-period stable pulsations (Lpc) in the middle latitudes during geomagnetic activity are reported. The penetration of polar disturbances and Lpc into middle latitudes is described. (R.E.U.)

11044 CHARACTERISTICS OF THE MOTION OF CHARGED PARTICLES IN THE GEOMAGNETIC FIELD. A. F. Kovalevskii (Tomsk State Univ., Siberian SSR). Geomagnetism Aeronomy, 3: 37-44(1963).

The motion of a charge in the magnetic trap of the earth is examined. A number of characteristics of proton and electron motion are obtained from a numerical solution of equations for the motion of a charge in the geomagnetic field. The path length of a charge between mirror points, the period of particle oscillation, latitudinal drift during one period, the average angular drift speed, the period of rotation around the earth, the linear drift speed, etc., are given. (auth)

11045 VARIATIONS IN THE INTENSITY OF AURORAL LUMINOSITY AND GEOMAGNETIC DISTURBANCES. G. A. Loginov, M. I. Pudovkin, and R. G. Skrynnikov (Polar Geophysical Inst., Academy of Sciences, Kola Branch, USSR). Geomagnetism Aeronomy, 3: 45-7(1963).

The relation between variations in the integral intensity of auroral luminosity and geomagnetic disturbances of bay and irregular fluctuation types are examined. It is shown that disturbances of these types arise from a common cause, i.e., the change in ionization in the upper atmosphere. Recombination rates are determined. (auth)

11046 N(h)-PROFILES OF THE IONOSPHERE OVER MOSCOW DURING THE MAGNETIC-IONOSPHERIC DISTURBANCES OF NOVEMBER 1960. N. I. Potapova and B. S. Shapiro (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 48-56(1963).

A comparison is made between changes in the parameters of N(h)-profiles over Moscow during the disturbances of November 1960 and changes in N(h)-profiles during the disturbances in July 1959. It is shown that the general nature of variations in the height distribution of ionization at middle latitudes during intense magnetic-ionospheric disturbances with sudden commencements remains approximately the same in winter and summer. (auth)

11047 SPACE-TIME DISTRIBUTION OF AN IONOSPHERIC DISTURBANCE AT HIGH LATITUDES OF THE NORTHERN AND SOUTHERN HEMISPHERES AFTER LARGE CHROMOSPHERIC FLARES. R. A. Zevakina (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 62-9(1963).

Synoptic charts of the ionospheric disturbance (Δf_{min}, fE_s, and Δf_0F_2) in the Northern and Southern Hemispheres at the time of two very large disturbances on September 12 to 15 and 20 to 26, 1957, are examined. During the first

disturbance, absorption increased in the polar cap and in the auroral zone prior to the geomagnetic storm without significant changes in the E_s and F_2 regions. During the second disturbance an abrupt increase in absorption in the polar cap and in the auroral zone was accompanied by a strong decrease in f_0F_2 in these regions. It is suggested that in the first case, high-energy protons that have caused the anomalous absorption are propagated at a high speed independent of the velocity of the stream. In the second case the high-energy protons were trapped by the magnetic field of the corpuscular stream and thus reached the earth at the same time as the main plasma stream. It is shown that the anomalous change in absorption as well as the increase in f_0F_2 occur approximately at the same time in the Northern and Southern Hemispheres. The decrease in f_0F_2 and the increase in fE_s spread over a larger area and are more stable in the Northern Hemisphere than in the Southern. (auth)

11048 CHARACTERISTICS OF THE DIURNAL DISTRIBUTION OF IRREGULAR MAGNETIC DISTURBANCES BETWEEN THE GEOMAGNETIC AND THE GEOGRAPHIC POLES IN THE ARCTIC. A. P. Nikolskii (Arctic and Antarctic Scientific Research Inst., USSR). Geomagnetism Aeronomy, 3: 83-9(1963).

Data from drifting stations, when they were located in the region between the geographic and the geomagnetic poles, are analyzed. It is found that in the diurnal distribution of magnetic activity (when estimated from its hourly amplitude) the changes of the disturbance vector in the horizontal plane have four maxima at 9.3, 3.8, 20.6, and 14.0 h geomagnetic time. The scatter of the time of the maxima averages ±1.0 h. The intensity of the maxima differs in various months. It is striking that the times of the maxima agree well with the time of appearance of impact zones on Störmer's precipitation spiral at 9.0, 2.8, 20.0, and 13.6 h. According to Störmer's theory, disturbances in the region under consideration may result from an outburst of solar corpuscular streams having a velocity from 10^7 to 10^9 cm/sec. (auth)

11049 LONG-PERIOD GIGANTIC GEOMAGNETIC FIELD PULSATIONS. A. I. Ol' (Arctic and Antarctic Scientific-Research Inst., USSR). Geomagnetism Aeronomy, 3: 90-5(1963).

A special type of gigantic pulsation Pgl was found in the magnetograms of polar observatories. The main characteristics of Pgl are their regular form, high amplitude (tens and hundreds of γ), and long period (hundreds of seconds). It was found that the period of Pgl increases with latitude. The curve for the diurnal variation of the frequency of appearance of Pgl exhibits two maxima, at 8 and 16 hours geomagnetic time. The relative intensity of the maxima depends on latitude and season. The period of the pulsations corresponding to the various maxima depends differently on latitude and the phase of the solar activity cycle. It is assumed that Pgl pulsations result from magnetohydrodynamic waves that are generated at the boundary of the exosphere. It is shown that the period of Pgl must be proportional to the square of the secant of geomagnetic latitude. (auth)

11050 RECENT TECTONIC MOVEMENTS AS ONE OF THE MANIFESTATIONS OF SOLAR ACTIVITY. A. D. Sytinskii (Arctic and Antarctic Scientific Research Inst., USSR). Geomagnetism Aeronomy, 3: 120-6(1963).

Some considerations concerning the possible dependence of recent tectonic movements on changes in the relative speed of rotation of the earth that are caused by variations in solar activity are reported. It is assumed that the effect of solar corpuscular streams must produce a change in the angular speed of rotation of the earth. The results of statistical analysis of solar and seismic data for 60 years are given in support of the assumptions made. A relation is established between seismic activity and the 11-year and secular solar cycles and active regions on the sun. An increase in seismic activity occurs near the extreme of the 11-year solar activity cycle, while individual strong earthquakes occur chiefly 2 to 3 days after the passage of an active region through the central solar meridian. (auth)

11051 THEORETICAL INVESTIGATIONS OF THE STRUCTURE OF THE F2 LAYER AND THE OUTER IONOSPHERE. K. H. Schmelovskii. Geomagnetism Aeronomy, 3: 165-71(1963).

The electron distribution in the region between 200 and 1500 km is determined by photoionization, recombination, and diffusion. Equations that take these processes into account are discussed. It is shown that above the maximum of the F2 layer the electron-ion plasma behaves as a gas with the molecular weight 8. Its temperature therefore can be computed from the exponential decrease of the electron concentration with height. Mean diurnal vibrations, were computed and are shown to be in good agreement with theoretical values. However, the seasonal differences in the total number of electrons and the electron concentration cannot be explained so simply. A new hypothesis is given for interpretation of these differences. The basis for this hypothesis is the diffusion of part of the electrons from the summer hemisphere into the winter hemisphere. (auth)

11052 THE MAGNETIC FIELD OF THE RING CURRENT. A. D. Shevnin (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 172-9 (1963).

A general solution of the problem of the magnetic field of a toroidal current of constant density is given. The formulas for computation of the magnetic field are given in toroidal and cylindrical systems of coordinates. The latter are used for computation and graphic representation of the magnetic field of a toroidal current and of the current model of superposed tori applicable to the extraionospheric ring current. The magnetic fields of the indicated current models are compared and their geophysical implications are stated. (auth)

11053 SOME PROBLEMS CONCERNING THE MORPHOLOGY OF AURORAS AND MAGNETIC DISTURBANCES AT HIGH LATITUDES. Ya. I. Feldshteyn (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 183-92(1963).

Photographic observation data of auroras in a winter period of the IGY were used in an analysis of the orientation of elongated auroral forms in the Northern and Southern Hemispheres. A comparison of the orientation of elongated auroral forms and the disturbance vector of the geomagnetic field is made. Auroral zones for all hours of the day that characterize the distribution of nighttime auroras are discussed. (auth)

11054 THE LATITUDINAL DIURNAL DRIFT OF AURORAS. N. I. Dzyubenko (Kiev State Univ.). Geomagnetism Aeronomy, 3: 193-7(1963).

A study was made of the latitudinal diurnal drift of auroras at 27 arctic and 12 antarctic stations on the basis of observational data for 1957 to 1959. (auth)

11055 THE AZIMUTHAL AND GEOGRAPHIC DISTRIBUTION OF AURORAL RAYS REVEALED BY DATA FOR THE YAKUTSK NETWORK OF STATIONS. V. P. Samsonov and N. S. Zaretskii (Yakutian Branch, Academy of Sciences, Siberian SSR). Geomagnetism Aeronomy, 3: 198-202(1963).

Effects were found of anomalous azimuthal and irregular geographic distribution of auroral rays over the area of the Yakutian, ASSR. A correspondence of this distribution to the local structure of the earth's magnetic field was discovered. A coastal effect in the distribution of rays, discovered earlier also was noted. (auth)

11056 THE RELATIONSHIP BETWEEN DISTURBANCE OF THE F2 LAYER AND PLANETARY MAGNETIC ACTIVITY. A. S. Besprozvannaya (Arctic and Antarctic Scientific Research Inst., USSR). Geomagnetism Aeronomy, 3: 211-17(1963).

The results of an analysis of the relation between disturbance of the F2 layer and magnetic activity are given on the basis of data for 30 stations situated to the north of 55° geomagnetic latitude during the period from April through September, 1958. There is shown to be a change of the correlation coefficient between K_p and disturbance of the F2 layer during the day and with latitude. The most representative hours for the relation between disturbance in the F2 layer and planetary magnetic activity in the equinoctial months are the morning hours at latitudes to the north of the auroral zone (more than 70° Φ), the daytime hours for stations within the zone, and the nighttime hours for latitudes to the south of the auroral zone. In the summer months at all the latitudes considered the relation between K_p and disturbance of the F2 layer is maximal in the early morning hours. There is shown to be a relation between the planetary ionospheric disturbance, evaluated on the basis of the area occupied by the disturbance in the F2 layer, and planetary magnetic activity. The correlation coefficient is 0.8 to 0.9. (auth)

11057 THE INFLUENCE OF DIURNAL VARIATION OF THE ELECTRIC CONDUCTIVITY OF THE IONOSPHERE ON THE SPECTRUM OF Sq VARIATIONS. G. I. Grigorev and V. P. Dokuchaev (Gorkii State Univ., USSR). Geomagnetism Aeronomy, 3: 237-9(1963).

The effects of temporal change of electric conductivity of the dynamic region of the ionosphere on the spectrum of quiet diurnal variations of the geomagnetic field are considered. It is shown that the spectra of geomagnetic variations with time for constant electric conductivity do not coincide. (auth)

11058 SPHERICAL ANALYSIS OF THE MAIN GEOMAGNETIC FIELD AND SECULAR VARIATIONS. N. V. Adam, N. P. Benkova, V. P. Orlov, N. K. Osipov, and L. O. Tyurmina (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR and Inst. of Mathematics and Computation Center, Academy of Sciences, Siberian SSR). Geomagnetism Aeronomy, 3: 271-85(1963).

Spherical analyses of the main geomagnetic field and the field of secular variations were made for a number of epochs in the period 1932 to 1958. Isopor maps for three periods of time were also analyzed. It is demonstrated that time changes of the geomagnetic field coefficients for short periods can be defined adequately only if there are uniform initial data and a uniform computation method is used. This group of analyses gives a general idea of the mean time changes for long periods. A study of secular variations of the dipole field for recent decades reveals a slowdown in the decrease of the value of the earth's magnetic moment in the period 1940 to 1950. No appreciable changes were noted in the position of the geomagnetic poles. The predominantly westerly direction of the longitudinal drift of harmonic terms was maintained during the entire period 1930 to 1960, but its rate was dissimilar for different harmonic terms and not constant; an easterly drift is noted for certain harmonics. (auth)

11059 THE OUTER PART OF THE EARTH'S MAIN MAGNETIC FIELD. N. K. Osipov (Inst. of Mathematics and Computation Center, Academy of Sciences, Siberian SSR). Geomagnetism Aeronomy, 3: 286-92(1963).

The problem of the outer part of the main magnetic field is discussed on the basis of the results of an analysis of the earth's main magnetic field for the period 1932-1958. It is shown that the outer part delineated for analysis is real. The hypothesis of the radiation belts as possible sources of the outer field is discussed. (auth)

11060 THE EXTENT OF AURORAL ARCS AND THEIR ORIENTATION IN SPACE. O. V. Khorosheva (Moscow State Univ.). Geomagnetism Aeronomy, 3: 294-7(1963).

Photographic observations of the extent and orientation of auroral arcs are discussed. (R.E.U.)

11061 SOME ADDITIONAL COMMENTS ON THE DIURNAL AND GEOGRAPHIC DISTRIBUTION OF IONOSPHERIC AND MAGNETIC-IONOSPHERIC DISTURBANCE. V. G. Dubrovskii and S. A. Kramarenko (Dept. of Exploratory Geophysics and Seismology, Academy of Sciences, Turkmen SSR). Geomagnetism Aeronomy, 3: 299-301 (1963).

The relation of ionospheric disturbances for magnetically quiet and magnetically active days is discussed. (R.E.U.)

11062 A PECULIARITY IN THE OCCURRENCE OF THE PRELIMINARY NEGATIVE IMPULSE IN SSC. K. C. Ivanov and N. V. Mikerina (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 305-8 (1963).

Tellurograms for earth-current stations were used to study the occurrence of the preliminary negative impulse in sudden-commencement geomagnetic storms. The distortions in SSC are assumed to arise from electromagnetic induction in the ionospheric E layer. (R.E.U.)

11063 GEOACTIVITY AND ITS POSSIBLE CAUSES (PRELIMINARY COMMUNICATION). V. I. Afanaseva (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 316-17(1963).

An 11-year cyclic change of the mean geographic latitude of the regions of most frequent earthquakes is discussed. Correspondence of the shift to changes of the inner motion of matter in the earth's liquid core is discussed. (R.E.U.)

11064 ON THE THEORY OF HYBRID WHISTLERS. H. Unz (Ohio State Univ., Columbus). J. Atmospheric Terrest. Phys., 24: 765-70(Sept. 1962).

It is suggested that the reason for the multiple, discrete, well-defined components in the nose whistlers is the different electron steams of discrete velocities along the same geomagnetic line. This new hypothesis is discussed in detail, and it is shown that the experimental evidence agrees with the analysis. (auth)

11065 LARGE-SCALE AURORAL MOTIONS AND POLAR MAGNETIC DISTURBANCES. III. THE AURORA AND MAGNETIC STORM OF 11 FEBRUARY 1958. S.-I. Akasofu

(Univ. of Alaska, College) and S. Chapman. J. Atmospheric Terrest. Phys., 24: 785-96(Sept. 1963).

The drastic changes that occurred in the distribution of the arctic aurora during the great magnetic storm of February 11, 1958, are described, on the basis of the records of the auroral all-sky cameras in North America, together with one in East Siberia and the one in Japan. Over the dark hemisphere, the aurora occurred overhead in a strip of varying width that lay parallel to the auroral zone. Its northern border fluctuated considerably during the storm, in parallel with the occurrence of polar magnetic substorms (DP) during the main storm. In the quiet intervening intervals, the northern border of the strip of aurora descended to geomagnetic latitude 50°N. During these quiet intervals, the aurora was completely absent from the region of the auroral zone, where normally it is most frequent and intense. During the DP's the strip was widest and expanded mainly by northward movement of its northern border. The southern border moved slightly southward at the same time, but its latitude was nearly constant throughout the main D_{st} phase of the storm. An explanation is suggested in terms of the varying distribution of particles in the region of the Van Allen belts. (auth)

11066 USES OF THE THERMAL FLUX FROM NUCLEAR EXPLOSIONS IN STUDYING ATMOSPHERIC GLOW MECHANISMS. I. L. Kofsky (Technical Operations Inc., Burlington, Mass.). J. Atmospheric Terrest. Phys., 24: 797-803(Sept. 1963).

The study of upper-atmosphere chemical processes with the aid of the intense pulse of visible and ultraviolet light that is emitted in a nuclear explosion is discussed. It is shown that the large-scale photodissociation effects can help explain the excitation mechanism of most of the principal natural airglows. In addition, this strong artificial lamp can be used as a source for stimulating and studying the twilight flashes, for observing recombination processes, and even for measuring the concentration and ultraviolet absorption of atmospheric species. (auth)

11067 GEOMAGNETIC CONTROL OF DIFFUSION IN THE F2-REGION OF THE IONOSPHERE. I. THE FORM OF THE DIFFUSION OPERATOR. P. C. Kendall (Univ. of London). J. Atmospheric Terrest. Phys., 24: 805-11(Sept. 1963).

The mathematical form of the diffusion operator is derived for motion of electrons along the lines of force of a dipole approximation to the geomagnetic field. The earth's atmosphere is assumed to be isothermal and horizontally stratified. A table is given of the various forms of the diffusion operator in different independent coordinates. The results are applied to a discussion of the form of the boundary condition at great height in the F2-region. (auth)

11068 STUDY OF IONIC OSCILLATIONS OF PLASMA. THEIR ROLE IN THE RESPONSIBLE MECHANISM OF IONOSPHERIC WINDS. D. Lepechinsky and P. Rolland (CEN, Saclay, France). J. Atmospheric Terrest. Phys., 24: 813-22(Sept. 1963). (In French)

The investigation of ionospheric winds by the three-receiver method usually leads to a considerable spread of the individual wind vectors and even to sudden reversals of the apparent wind during time intervals of the order of 10 min. or less. This well-known behavior is dealt with by the determination of a "mean" wind vector, whether by the center of gravity of the cloud of the experimental points or by the diameter of the best fit circle, which supposes the existence of continuous contours of the moving irregularities. The mechanism responsible for similar amplitude fluctuations on three simultaneous field strength records has previously been explained on different grounds (large-scale ionization transport, internal gravity waves, etc.) but none of these suggestions appears to adequately explain the rather erratic movements that are so often observed during wind measurements. As a possible cause of the similar fades observed and of the apparent drift of ionospheric irregularities, the propagation of ionic wave packets produced by the interaction of solar corpuscular charge-carrying beams with the ionospheric plasma was considered. This hypothesis is shown to be consistent with the physical properties of the media and with the wind velocities usually found (which are of the order of the ionospheric thermal velocities), and also accounts for the rapid wind reversals that are observed. (auth)

11069 IONOSPHERIC D-REGION PHENOMENA ASSOCIATED WITH AURORAL DISTURBANCES AT SODANKYLÄ. W. Dieminger, J. Oksman, and G. Rose (Max-Planck-Institut für Aeronomie, Lindau, Ger. and Geophysical Observatory, Sodankylä, Finland). J. Atmospheric Terrest. Phys., 24: 823-4(Sept. 1963).

Observations of auroral effects on the ionosphere over Finland on Dec. 3, 1961, are reported. The daily height variations of weak, low echos (D) appearing on ionograms were studied at 70 to 90 km. (R.E.U.)

11070 E_s OCCURRENCES IN RELATION TO SOLAR ACTIVITY. R. K. Mitra and M. K. Dasgupta (Calcutta Univ.). J. Atmospheric Terrest. Phys., 25: 415-27(Aug. 1963).

Percentage occurrence data of midday E_s (percentage of times fE_s >5 Mc/s) for thirty-three stations in different regions of the globe were examined in relation to the solar activity for the period 1953 to 1959. The results obtained from statistical analysis can be summarized as follows: for twenty-three stations the percentage occurrences of E_s were much greater in the sunspot maximum year than those of the minimum year and in general, these were positively correlated with sunspot activity; for three stations the reverse was the case and the correlation between the two phenomena was found to be negative; and for the remaining seven stations percentage occurrences of E_s did not show any marked preference to either the minimum or the maximum year of sunspot activity and in general, for these stations, the nature of the correlation was not clearly discernible. These stations were designated as A-, B-, and C-type stations, respectively. It was also observed that three distinct E_s zones; — auroral, temperate, and equatorial existed having the following characteristic features: (a) E_s occurrences in majority of the temperate zone stations, irrespective of any longitudinal zone and also those in most of the auroral stations in the east intermediate longitudinal zone show definite positive correlation with solar activity, (b) for auroral stations in both the west and west intermediate longitudinal zone, the correlation is (i) negative for stations in maximum auroral frequency belt and (ii) either positive or not clearly discernible for stations outside this belt, and (c) for equatorial stations the correlation is negative. It was observed that in general a well defined parabolic relation existed between the two phenomena. The high sunspot activity of the present solar cycle seems to be responsible for this nonlinear relation as also for the well defined correlations observed for the majority of the stations. (auth)

11071 A COMPARISON OF ELECTRON DENSITY PROFILES OVER AHMEDABAD IN YEARS OF LOW AND HIGH SOLAR ACTIVITY. J. S. Shirke (Physical Research Lab.,

Ahmedabad, India). J. Atmospheric Terrest. Phys., 25: 429-40(Aug. 1963).

The median vertical distributions of electron density over Ahmedabad (23°01 N, 72°36 E) in January, April, July, and October in the years of low and high solar activity, 1954 and 1957 to 1958, were calculated from ionograms. The P'f records on all the days of the month for the same local hour were superposed and the monthly median p'f curve interpolated. This was then subjected to true height analysis by applying the standard Schmerling method used for the analysis of individual curves. The diurnal electron densities are presented in the form of iso-electron-density contours against height. The curves are extrapolated above the level of maximum electron density assuming Garriott's model for the distribution. The major features of diurnal and seasonal variation are discussed. (auth)

11072 MEAN ELECTRON COLLISION FREQUENCY IN THE IONOSPHERE. P. F. Checcacci and M. T. de Giorgio (Centro Microonde del Consiglio Nazionale delle Richerche, Florence). J. Atmospheric Terrest. Phys., 25: 597-8(Oct. 1963).

Simultaneous measurements were made of the whole ionospheric absorption and of the total ionospheric electron content to obtain information on the mean electron collision frequency in the ionosphere. The cosmic noise method was used for absorption measurements, and r-f signals from artificial satellites were used for content analyses. (R.E.U.)

11073 SOME OBSERVATIONS OF HYDROGEN-LINE PROFILES IN THE AURORA. H. H. Zwick and G. G. Shepherd (Univ. of Saskatchewan, Saskatoon, Can.). J. Atmospheric Terrest. Phys., 25: 604-7(Oct. 1963).

Horizon and zenith profiles of hydrogen lines in the aurora were analyzed. Directions and energy distribution of incoming protons can be determined from the data. The observations of several authors are reviewed. (R.E.U.)

11074 OBSERVATION OF DAYTIME AURORA. J. F. Noxon (Harvard Univ., Cambridge, Mass.). J. Atmospheric Terrest. Phys., 25: 637-45(Nov. 1963).

Daytime aurora was detected from the ground using a spectral scanning polarimeter. Observations made at Fort Churchill, Manitoba during December 1962 revealed intensities for the green (5577 Å) and red (6300 Å) lines of oxygen of up to 30 kR on a magnetically disturbed day; subsequent observations on a quiet day gave intensities for both lines of less than 2 kR. The daytime aurora was not accompanied by radar echoes. (auth)

11075 INTEGRAL AND SPHERICAL-HARMONIC ANALYSES OF THE GEOMAGNETIC FIELD FOR 1955.0. PART I. E. H. Vestine, W. L. Sibley, J. W. Kern, and J. L. Carlstedt (RAND Corp., Santa Monica, Calif.). J. Geomagnet. Geoelec., 15: 47-72(1963).

The geomagnetic field is analyzed by spherical harmonics. Series representations in spherical harmonics of geomagnetic field charts are compared for truncation of the series at terms of degree 6, 8, 10, and 12. Scalings are at a uniformly spaced latitude-longitude grid from both U.S. and U.S.S.R. isomagnetic charts for 1955.0. Some minor but undesirable effects are mentioned that arise because of the uniform angular spacing of data points scaled from charts. The variation of the earth's magnetic moment and the location of the dipole axis since 1835 is described and discussed. It is shown that spherical harmonic coefficients of secular change for 1912.5, 1922.5, 1932.5, and 1942.5 seen roughly compatible with those of Nagata and Oguti for 1958.5, even though earlier data analyzed were defective in Antarctica; evidently the precision of determination of the coefficients of secular change is not high. Finally, an extrapolation of the geomagnetic field into the earth's interior is described. (auth)

11076 INTEGRAL AND SPHERICAL-HARMONIC ANALYSES OF THE GEOMAGNETIC FIELD FOR 1955.0. PART 2. E. H. Vestine, W. L. Sibley, J. W. Kern, and J. L. Carlstedt (RAND Corp., Santa Monica, Calif.). J. Geomagnet. Geoelec., 15: 73-89(1963).

A numerical integration method for analyzing the geomagnetic field is developed from Poisson's integral. A new surface grid, suitable for use with integral analysis, is described. This grid is based on subdivisions of a spherical icosahedron, and its points are almost uniformly spaced over a sphere. This integration method is applied to calculations of field values, field lines, and conjugate points. The results are compared with those of earlier spherical-harmonic analyses. A comparison is also made between those conjugate points calculated by spherical harmonics from different sets of coefficients derived from various sets of isomagnetic charts. (auth)

11077 THE IONOSPHERIC ABSORPTION OF THE VLF EMISSIONS AT THE AURORAL ZONE. Tadanori Ondoh (Radio Research Labs., Nakaminato, Ibaragi, Japan). J. Geomagnet. Geoelec., 15: 90-108(1963).

Ionospheric absorptions of v-l-f emissions at the auroral zone were calculated along a geomagnetic line of force connecting with the earth's surface at geomagnetic latitude of 64° by using the longitudinal approximation of the Appleton-Hartree formula and data of rocket sounding and of auroral luminosity profiles. Ionospheric absorptions at 4 kc between 50 and 170 km height are of 33.1, 15.4, 16.9, and 2.2 db for a daytime ionosphere during total polar black-out, a quiet ionosphere near noon, a midnight ionosphere during diffuse aurora, and a quiet ionosphere at winter midnight, respectively. Therefore the lack of v-l-f emissions during total polar black-out at high latitudes may be due to the marked increase of the absorption in the ionosphere, especially in the D layer. On the other hand, it seems likely that particles producing auroras and geomagnetic disturbances around the E layer do not cause considerable absorption of the v-l-f emissions, and that the power of v-l-f emissions is originally weak in the exosphere on night side at the auroral zone. The absorption of 15.4 db in the quiet ionosphere near noon suggests that the original power of v-l-f emissions in the exosphere is of the order of $3.5 \times 10^{-13} \sim 3.5 \times 10^{-15}$ wm^{-2} $(c)^{-1}$ in the daytime. The diurnal variation in maximum chorus frequency at high latitudes may be explained by relative increase of ionospheric absorption during the daytime for frequencies above a few kilo-cycles. (auth)

11078 DIURNAL VARIATION IN THE AMPLITUDE AND FREQUENCY OF MAGNETIC "SUDDEN COMMENCEMENTS" AND "SUDDEN IMPULSES" AT QUETTA. S. A. A. Kazmi (Geophysical Inst., Quetta, Pakistan). J. Geomagnet. Geoelec., 15: 109-15(1963).

The study of diurnal variation in the frequencies and amplitudes of magnetic sudden commencements (SC^S) and sudden impulses (SI^S) recorded at Quetta (lat. 30°11'N; long. 66°57'E), during the period 1953–1962 indicates that SC^S and SI^S are more frequent near the sunrise and sunset hours with maxima around 06^h and 18^h local time (L.T.). This does not conform to the curves obtained by Newton and Ferraro & others which exhibit a maximum at 13^h L.T. and two minima at 08^h and 20^h L.T. respectively. The mean hourly values of the amplitude y of SC^S & SI^S

do not seem to exhibit any marked local time effect. The daytime enhancement in y and the similarity between the diurnal variation of amplitude of SC^S & SI^S and Sq-variation found at Huancayo, Kodaikanal, and Alibag is also absent. On the other hand a sharp minimum in the amplitude curve around 07^h L.T. gives weight to Ferraro's contention that during the day-lit hemisphere the higher conductivity of the ionosphere tends to shield the station below from the external magnetic field produced by corpuscular stream. No seasonal variation in the monthly frequency of SC^S & SI^S is discernible but the mean monthly amplitude curve exhibits marked enhancement in the size of SC^S & SI^S during the summer months. The curves for the annual mean number and yearly mean amplitudes of SC^S & SI^S and yearly mean Sq-range show striking similarity to the curve for the annual mean sunspot numbers. A linear relation of the type $y = 11.6 + 0.097s$ between the amplitude y and the relative sunspot numbers s was worked out for Quetta. (auth)

11079 WAVE GENERATION NEAR THE OUTER BOUNDARY OF THE MAGNETOSPHERE. Peter D. Noerdlinger (Univ. of Chicago). J. Geophys. Res., 69: 369-75 (Feb. 1, 1964).

It is shown that certain plasma instabilities can explain the enhanced and fluctuating magnetic field observed in the layer of disturbed plasma lying between the magnetosphere and the solar wind. Unstable ion waves grow into nonlinear behavior during approximately the foremost one-fourth of that region. The resulting turbulence, with perhaps some residual oscillation at the frequency of the unstable waves, persists through the rest of the region. (auth)

11080 ALBEDO NEUTRONS IN SPACE. D. J. Williams and C. O. Bostrom (Johns Hopkins Univ., Silver Spring, Md.). J. Geophys. Res., 69: 377-91(Feb. 1, 1964).

A time history of the neutron albedo at ~1000 km and ~40°N magnetic latitude covering some 240 days is presented. A time variation of about a factor of 2 occurred in the vicinity of day 95, 1962. A latitude variation is also presented covering the range from 27 to 45°N magnetic latitude. The final results were corrected for local neutron production and agree more closely with the results of Hess, Canfield, and Lingenfelter than with the recent results of Lingenfelter. No longitude effect was observed for the neutron albedo, although such an effect is found for the incident cosmic rays. A comprehensive review of all published neutron albedo measurements and comparisons to various theoretical results is presented. (auth)

11081 AN EXPLANATION FOR THE APPARENT POLARIZATION OF SOME GEOMAGNETIC MICROPULSATIONS (PEARLS). Joseph H. Pope (National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 69: 399-405 (Feb. 1, 1964).

Studies of the polarizations of the micropulsation phenomenon, pearls, show a number of remarkable effects, in particular, reversals in sense of rotation. The possibility that the superposition of a succession of signals having rising tones can produce the effects in question, is considered. It is shown that, if a number of signals of elliptical polarization all identical except for the inclination of the major axis and frequency are observed simultaneously, various effects, including apparent reversals in sense of rotation, will occur. (auth)

11082 ANALYSIS OF TOPSIDE SOUNDER RECORDS. R. J. Fitzenreiter and L. J. Blumle (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 69: 407-15 (Feb. 1, 1964).

A large number of features can be seen on the ionograms obtained by the topside sounder satellite. The most useful feature for the calculation of electron density profile is the extraordinary trace; however, to achieve accurate results, the effect of the geomagnetic field must be carefully considered in the data reduction process. The method of analysis selected assumes that small sections of the profile can be approximated by exponential laminations. This method requires fewer points than other first-order lamination techniques to achieve a given accuracy. It is usually assumed in the analysis that the received echoes correspond to vertical propagation. This assumption is not always valid, and it can in some cases lead to large errors. The sounder also excites the medium in the immediate vicinity of the satellite, giving rise to various plasma resonances. A graph is given that summarizes the local effects that are seen on the ionograms. This graph can be used for a rapid identification of these resonances. (auth)

11083 GEOMAGNETIC CONTROL OF THE ELECTRON DENSITY IN THE F REGION OF THE IONOSPHERE. R. A. Goldberg (Goddard Space Flight Center, Greenbelt, Md.), P. C. Kendall, and E. R. Schmerling. J. Geophys. Res., 69: 417-27(Feb. 1, 1964).

The solution of a problem recently treated by Goldberg and Schmerling is written in a simple closed form. The problem concerns a possible explanation of the geomagnetic anomaly in terms of diffusion along the magnetic lines of force for a special model of the F_2 layer at the magnetic equator. At great height the results obtained are roughly in agreement with observations made by the Alouette (S-27) satellite on October 3, 1962. The theoretical electron density at fixed height is given as a function of magnetic latitude for a wide range of expected conditions at various phases of the solar cycle. Curves showing the latitude variations of $[\partial(\log N)/\partial r]^{-1}$ at great height are also given. The results are discussed. (auth)

11084 RADAR-LUNAR MEASUREMENTS OF THE ELECTRON CONTENT OF THE IONOSPHERE. George H. Millman (General Electric Co., Syracuse, N. Y.). J. Geophys. Res., 69: 429-40(Feb. 1, 1964).

The Faraday rotation of 425-Mc radar signals reflected from the moon's surface was analyzed to yield data on the ionization in the ionosphere. The experimental measurements were taken at Trinidad, West Indies, between January and July 1960. A method is presented that permits resolving the ambiguity of the number of rotations of the plane of polarization when one frequency is employed in radar-lunar studies. The total integrated electron density in a vertical column through the ionosphere inferred from the radar Faraday data is found to undergo a diurnal variation, having a maximum value during the late afternoon. An analysis of other ionospheric parameters, such as the equivalent slab thickness, the scale height, and the ratio of the electron content above the peak of the F layer to that below, is also presented. (auth)

11085 THE LONGITUDINAL VARIATION OF NIGHT AIRGLOW INTENSITY IN THE REGION OF THE SOUTH ATLANTIC MAGNETIC ANOMALY. J. A. Greenspan and C. A. Stone (Illinois Inst. of Tech., Chicago). J. Geophys. Res., 69: 465-9(Feb. 1, 1964).

Shipboard measurements made in the regions of the South Atlantic anomaly at a geomagnetic latitude corresponding to L = 1.80 suggest the existence of a region of increased airglow activity near 67° geomagnetic longitude. An attempt is made to show that this anomaly is not temporal in nature nor due to the effects of high-altitude nuclear tests carried out during these measurements. The location of this anom-

aly borders on but does not pass through the magnetic and trapped particle anomalies as previously measured, and, although the results suggest that this anomaly is dependent on longitude, the quantity of data is limited and confirmatory measurements will be required to substantiate this conclusion. (auth)

11086 DETERMINATION OF THE D-LAYER DISSOCIATIVE RECOMBINATION COEFFICIENT FROM A HIGH-ALTITUDE NUCLEAR EXPLOSION. R. E. LeLevier (RAND Corp., Santa Monica, Calif.). J. Geophys. Res., 69: 481-5(Feb. 1, 1964).

Measurements of the magnitude and time dependence of x-ray-induced absorption over Midway during the July 9, 1962, high-altitude nuclear explosion allows one to infer bounds on the dissociative recombination coefficient α of the D layer of the ionosphere. Analysis of the data indicates that α lies between 3×10^{-7} and 7×10^{-7} cm^3/sec. (auth)

11087 GEOMAGNETIC AND SOLAR DATA. J. Virginia Lincoln (National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 69: 525-9(Feb. 1, 1964).

Geomagnetic and solar data are given for June through Sept. 1963. Sudden commencement times, sudden pulses found in magnetograms, and solar flare effects are presented. Principal magnetic storm data also include storm time, type, activity, amplitude, range, and maximal activity on the K-scale. The indices Kp, Ci, Cp, Ap, and K_{Fr} and provisional sunspot numbers are given for Sept. (C.E.S.)

11088 IONOSPHERIC OSCILLATIONS FOLLOWING A NUCLEAR EXPLOSION. Harold D. Webb (Univ. of Illinois, Urbana) and Fred B. Daniels. J. Geophys. Res., 69: 545-6(Feb. 1, 1964).

An ionospheric phenomenon, which appeared to be caused by a Soviet nuclear explosion, was observed on linearly polarized radio signals from a 151-Mc transmitter that were reflected from the moon and passed through the ionosphere twice. It is proposed that the signal oscillations represent the motion of electrons caused by acoustic waves from the explosion. (C.E.S.)

11089 MAGNETIC DISTURBANCES DUE TO THE HIGH-ALTITUDE NUCLEAR EXPLOSION OF JULY 9, 1962. D. P. Miles and R. P. Lepping (U. S. Naval Air Development Center, Johnsville, Penna.). J. Geophys. Res., 69: 547-8(Feb. 1, 1964).

Magnetometer records taken during the explosion indicate an initial sharp decrease in field strength of about 1-sec duration beginning about 2 sec after detonation followed by large, rapid fluctuations of the field for several seconds. For the first 15 sec of the signal, the changes in field strength exceeded in amplitude and frequency the range and frequency response of the recorder. At 16 sec after onset the signal decreased sufficiently in amplitude and frequency to fall within the recorder response. (C.E.S.)

11090 SOME IMPLICATIONS OF A DIRECT MEASUREMENT OF THE HYDROGEN AND HELIUM ION DISTRIBUTION IN THE UPPER ATMOSPHERE. S. J. Bauer (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 69: 553-5(Feb. 1, 1964).

The possibility of deducing information on the physical processes, structure parameters, and, in particular, ion temperatures of the upper atmosphere from the ratio of the ionic constituents H^+ and He^+, is discussed. (C.E.S.)

11091 PITCH-ANGLE DISTRIBUTION OF THE PHOTOELECTRONS AND ORIGIN OF THE GEOMAGNETIC ANOMALY IN THE F_2 LAYER. F. Mariani (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 69: 556-60(Feb. 1, 1964).

The equatorial or geomagnetic anomaly, which consists of the pronounced minimum of f_0F_2 on the geomagnetic equator and two maxima near 20° north and south geomagnetic latitude at meridian hours and in the afternoon, is discussed. A mechanism that may play a role in the explanation of the anomaly is presented. The mechanism is based on a detailed analysis of the physical processes that photoelectrons (solar uv ray produced) undergo in the upper atmosphere. (C.E.S.)

11092 EVIDENCE ON THE HORIZONTAL DIFFUSION OF F-REGION IONIZATION ALONG THE MAGNETIC LINES OF FORCE IN EQUATORIAL LATITUDES. Y. V. Somayajulu (Pennsylvania State Univ., University Park). J. Geophys. Res., 69: 561-3(Feb. 1, 1964).

Changes in F-region ionization density in equatorial regions are analyzed, and evidence for horizontal diffusion of ionization along magnetic lines of force is presented. (C.E.S.)

11093 VAN ALLEN RADIATION BELTS. K. S. Raja Rao (Meteorological Office, Poona, India). J. Sci. Ind. Res. (India), 22: 360-2(Sept. 1963).

An account of the discovery of the two Van Allen radiation belts with the help of the space probes is given. The various mechanisms of the motion of geomagnetically trapped particles are considered. The structure of the two belts, the various theories regarding their origin, and the extent of solar contribution are discussed. The relation between the changes in these radiation belts and magnetic storms, and the possible existence of a third radiation belt are also discussed. (auth)

11094 ČERENKOV RADIATION IN A MAGNETO-IONIC MEDIUM (WITH APPLICATION TO THE GENERATION OF LOW-FREQUENCY ELECTROMAGNETIC RADIATION IN THE EXOSPHERE BY THE PASSAGE OF CHARGED CORPUSCULAR STREAMS). J. F. McKenzie (Cambridge Univ., Eng.). Phil. Trans. Roy. Soc. London, Ser. A, 255: 585-606(July 11, 1963).

The electromagnetic field of a uniformly moving point charge in a magneto-ionic medium is evaluated by representing the field due to the moving charge in an angular spectrum of plane waves. A brief discussion of the frequency ranges satisfying the Cherenkov coherence condition is given. It is shown that Cherenkov radiation in the exosphere produces low-frequency hiss. The spectral and polar distributions of radiation over the low-frequency band were computed numerically for plasma and gyro frequencies occurring in the exosphere and for particle speeds of the order of solar corpuscular cloud speeds. An interesting feature of the radiation is that the more slowly the particle moves the greater is the emitted radiation. (auth)

11095 POLAR GEOMAGNETIC DISTURBANCES. Takesi Nagata (Tokyo Univ.). Planetary Space Sci., 11: 1395-1429(Dec. 1963).

Results of recent observations of geomagnetic disturbances in both northern and southern high latitudes are reviewed, and various theories on these phenomena are introduced. A geomagnetic daily variation, observed in the polar areas on magnetically quiet days, is discussed. The morphology of the polar part of the sudden commencement of magnetic storms is described. The morphology of the auroral electrojets is discussed on the basis that they are sporadic and intermittent phenomena. The interrelation among the auroral electrojet intensity, auroral luminosity, and auroral sporadic ionization of the ionosphere is dis-

cussed. Results of observational studies on the conjugate relation of geomagnetic bays and giant magnetic pulsations observed in high latitudes are summarized. A conjugate of stations is defined with respect to the unperturbed geomagnetic field. The so-called spiral patterns of polar magnetic disturbances are discussed, and a large number of patterns are proposed. Gaps in the existing knowledge of polar magnetic disturbances are discussed. 143 references. (R.E.U.)

11096 IONOSPHERIC CONDITIONS. Marcel Nicolet and William Swider, Jr. (Pennsylvania State Univ., University Park). Planetary Space Sci., 11: 1459-82(Dec. 1963).

A general analysis of ionospheric conditions was made in the light of possible ionic reactions occurring in the upper atmosphere. Data obtained on various parameters, such as ionic production and recombination, show that precise knowledge of the spectral distribution of solar radiation is needed and that other experimental determinations on dissociative recombinations are required. The ionic complexity of the ionosphere is underlined by describing how the atomic ions O^+ and N^+ react with N_2, O_2, and NO molecules. The behavior of the molecular ions N_2^+, O_2^+, and NO^+ depends on a group of simultaneous processes involving charge transfers and ion-atom interchanges that are more important than dissociative recombinations. The altitude distribution of ions is exemplified by discussing the relative importance of various loss coefficients in the D-, E-, and F-regions. It is seen that molecular nitrogen ions are subject to important charge transfer processes, that nitric oxide ions are always final products destroyed only by dissociative recombination. The entire production of atomic oxygen ions is related to the photoionization of molecular nitrogen. Some information is also given on possible anomalies in the ratio of O_2^+ and NO^+ densities in the lower ionosphere. From the lack of sufficient experimental information on ionic processes, it is shown that a precise analysis of ionospheric behavior remains highly speculative. 64 references. (auth)

11097 SOLAR RADIO BURSTS OF SPECTRAL TYPES II AND IV: THEIR RELATIONS TO OPTICAL PHENOMENA AND TO GEOMAGNETIC ACTIVITY. Barbara Bell (Harvard Univ., Cambridge, Mass.). Smithsonian Contrib. Astrophys., 5: No. 15, 239-57(1963).

Solar radio bursts of spectral types II and IV, observed in the years 1957 to 1960, are discussed in relation to flares, the magnetic class of the associated sunspot, the north-south asymmetry, and to geomagnetic and solar proton (PCA) effects. A total of 96 type IV and 197 type II bursts was studied. About 50 percent of the type IV and 28 percent of the type II bursts were associated with a major ($\geq 2^+$) flare. Sunspot groups of complex ($\beta\gamma$ and γ) magnetic class produced 61 percent of the type IV but only 36 percent of the type II bursts. Comparative data are given for sunspots, flares, and geomagnetic storm and PCA sources. The north-south asymmetry appears to increase with increasing intensity in various types of solar activity. Long-lived bursts of each type are more concentrated to the north than are short-lived bursts. But there is no significant difference between type II and type IV bursts in north-south distribution. The data indicate a very strong association between type IV bursts and great geomagnetic storms. The increase in probability of a great storm within three days after a type II burst is also significant but less striking. However, those type II bursts that were not accompanied by type IV appear to be significantly associated only with small storms. The bursts were subdivided by various properties. A major flare or a long duration of the burst each increases the probability of geomagnetic success. Type IV bursts lasting less than 15 minutes have little geomagnetic importance. Given a major flare with type IV emission, the magnetic class of the sunspot is of minor significance. However, a $\beta\gamma$ or γ sunspot is about five times more likely to produce a major flare with type IV emission than is a β or α spot group of comparable size. The inverse problem, of solar activity preceding geomagnetic storms, was analyzed as a function of storm intensity. A significant difference between recurrent and nonrecurrent storms was found, in that recurrent storms tend to avoid centers of major flare and radio burst activity. A strong association is found between type IV radio events and PCA events, with 23 of type IV bursts followed within a few hours by a PCA. The duration of the burst is positively related to the intensity of the PCA. A high percentage of proton events arise from complex sunspot groups. 35 references. (auth)

Low Temperature Physics

11098 (AD-407317) SUPERCONDUCTIVE EFFECTS IN THIN FILMS. Interim Engineering Report No. 5, January 15, 1963–April 15, 1963. S. Shapiro (Little (Arthur D.) Inc., Cambridge, Mass.). May 15, 1963. Contract AF33(657)-7915. 22p.

Improvements were made in the measurement of microwave cavity Q. A c-w local oscillator beating against the f-m signal klystron generates a band of beat frequencies. A tunable radio receiver selects the desired narrow band. After shaping by an R-C circuit, this band is used to trigger a pulse generator resulting in a pair of very sharp markers separated by a controllable and accurately measurable amount in frequency. Thus the bandwidth of the cavity characteristic can be accurately determined leading to a much improved Q measurement. Despite the use of thin Al films in low resistance crossings, or the use of poor R-C crossings, no quantum effects were observed in the presence of microwave power. It was noted that magnetic flux was sometimes trapped in the films forming the sample. This resulted in substantial rounding of the sharp corner in the I-V characteristic and care was taken to avoid the effect. The square wave response of a sample operated as a microwave detector was examined up to the limit of the oscilloscope used, less than 1 megacycle. The tunneltron response was found not limiting. Zero-voltage currents associated with the tunneling of electron pairs were observed in all low resistance samples. An a-c technique was used which permitted a demonstration that these currents were not due to superconducting short circuits. (auth)

11099 (AERE-R-4507) THE MAGNETIC FIELD DEPENDENCE OF SPIN WAVE SPECIFIC HEATS AT LOW TEMPERATURES. M. W. Stringfellow (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1964. 6p.

An expression for the difference between the spin-wave specific heat of ferromagnetic materials in a zero magnetic field and in a strong magnetic field is derived. Iron is treated as an example. (D.C.W.)

11100 (LNF-63/67) SOME EXPERIMENTAL RESULTS OF SUPERCONDUCTING SOLENOIDS. Note No. 217. G. Pasotti, N. Sacchetti, G. Sacerdoti, and G. Sanna (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Nov. 11, 1963. 15p.

The phenomena limiting the performance of a supercon-

ducting solenoid are reviewed, and some experiments on solenoids wound from Nb–Zr wire with various Zr contents are described. Irreproducibility of coil performance on successive trails was observed (possible causes are given), together with the impossibility of predicting coil performance in the design stage. Also, magnetic energy of the order of magnitude of the energy required to make the superconducting electrons go into the normal state was observed to be concentrated in a small volume. (D.C.W.)

11101 (LNF-63/78) TECHNICAL ASPECTS OF THE MEASUREMENT OF IONIC CURRENTS IN LIQUID HELIUM. Note No. 224. I. Modena and F. Scaramuzzi (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Dec. 11, 1963. 18p.

A review is presented of the techniques used in measurements of ionic currents in liquid He^3 and He^4. The general technical aspects pertaining to the measurements are first described, including cells, ion generation, and current detection. Finally, the main measurements that have been performed so far are described. (D.L.C.)

11102 (LNF-63/79) FURTHER MEASUREMENTS OF IONIC MOBILITIES IN SUPERFLUID HELIUM BY THE METHOD OF THE COMPLETE SPACE CHARGE LIMITATION. Note No. 225. F. Scaramuzzi (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Dec. 17, 1963. 13p.

The method of Bartoli and Scaramuzzi was used in further measurements of ionic mobilities in superfluid helium. Both negative and positive ions were studied, and the temperature region close to the lambda point was scanned accurately. The validity of the method is discussed, and the possibility of improving it is considered. (D.L.C.)

11103 (LNF-63/83) TEMPERATURE AND DENSITY DEPENDENCE OF IONIC MOBILITY IN LIQUID He^3. Note No. 229. P. de Magistris and I. Modena (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Dec. 20, 1963. 12p.

The ionic mobility of positive and negative ions in liquid He^3 was measured at different temperatures and densities. The results for the positive ions are quite consistent, while uncertainties occur in the data for the negative ions. Since the interpretation of the data is unsatisfactory, the classical models are discussed. (D.L.C.)

11104 (NIRL/R/53) THE ECONOMICS OF SUPERCONDUCTING MAGNETS IN HIGH-ENERGY PHYSICS. G. P. Haskell and P. F. Smith (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). Oct. 1963. 70p.

The various types of experimental magnets used in high energy physics are classified; and the production of the required field configurations by means of superconducting coils, conventional air-core and iron-core magnets, cryogenic coils, and pulsed coils, is discussed. Formulas for estimating the capital cost and ten-year cost of the different types of magnet are derived and used to obtain general and specific cost comparisons covering a wide range of experimental devices. The results are expressed in terms of superconducting current density and magnetic field, and it is shown that the majority of possible applications lie well within the foreseeable performance of known superconductors. (auth)

11105 ON THE PARAMAGNETIC EFFECT IN SUPERCONDUCTORS IN TRANSVERSAL MAGNETIC FIELD. E. Trojnar (Inst. of Physics, Polish Academy of Sciences, Wroclaw). Acta Phys. Polon., 24: 801-8(Dec. 1963).

The magnetic moment of the tin superconducting cylinder carrying current in a transverse magnetic field was measured. When the cylinder was in the intermediate state its magnetic moment obtained a paramagnetic sign, i.e. opposite to the sign of magnetic moment in completely superconducting state. It was found that, likewise the case of longitudinal field, the minimal current required for the appearance of the effect is, for tin, 1.2 amperes. It was stated that this paramagnetic effect was a result of circular superconducting currents, circulating in the plane perpendicular to the direction of the external magnetic field. (auth)

11106 SUPERCONDUCTIVITY. T. H. Geballe and B. T. Matthias (Bell Telephone Labs., Murray Hill, N. J.). Ann. Rev. Phys. Chem., 14: 141-60(1963).

The occurrence of superconductivity, nature of the superconducting state, and high-field superconductivity are reviewed. 177 references are included. (P.C.H.)

11107 EFFECT OF TENSILE STRAIN ON SUPERCONDUCTING TRANSITION TEMPERATURE OF Al FILMS. H. A. Notarys (California Inst. of Tech., Pasadena). Appl. Phys. Letters, 4: 79-80(Feb. 15, 1964).

The effects of tensile strain at low temperatures on Al thin films were studied using Mylar coated with ~0.043 μ Al. The film temperatures were 1.2 to 2.6°K with a largest change in critical temperature of 0.34°K. (R.E.U.)

11108 STUDIES ON PRODUCTION OF INTENSE FIELDS. R. Florent. Bull. Inform. Sci. Tech. (Paris), No. 77, 41-8(Nov. 1963). (In French)

Studies on the production of magnetic fields up to 200 kOe are reviewed. Particular attention is devoted to the use of superconductors in these magnets. (T.F.H.)

11109 UPPER CRITICAL FIELD OF Nb–Zr AND Nb–Ti ALLOYS. A. El. Bindari and M. M. Litvak (Avco-Everett Research Lab., Everett, Mass.). J. Appl. Phys., 34: 2913(Sept. 1963).

To test the validity of an expression for the upper critical field of superconducting alloys, Nb–Zr and Nb–Ti alloys were investigated. The heat capacity, electric resistivity, and transition temperatures were determined. When the measured values were substituted into the expression for the upper critical field, values in good agreement with experiment were obtained. (C.E.S.)

11110 PRECIPITATION AND SUPERCONDUCTIVITY IN LEAD–TIN AND LEAD–CADMIUM ALLOYS. J. D. Livingston (General Electric Research Lab., Schenectady, N. Y.). J. Appl. Phys., 34: 3028-36(Oct. 1963).

The effects of precipitation from solid solution on the superconducting properties of lead–tin and lead–cadmium alloys were studied by magnetization measurements at 4.2°K. Microstructural changes were followed by optical and electron microscopy. These alloys as-quenched are superconductors of the second kind, their upper critical fields enhanced by quenched-in solute. At various stages in the precipitation process, the upper critical field continues to be determined primarily by the remanent solute. Magnetic hysteresis and trapped flux result from the interaction between precipitates and the flux filaments of the mixed state, a given precipitate distribution causing much more flux trapping if the matrix is a superconductor of the second kind than if it is a superconductor of the first kind. Several instances are seen where superconducting magnetization measurements yield useful metallurgical information. (auth)

11111 MAGNETIC FIELD STABILIZATION WITH A SUPERCONDUCTING TUBE. R. D. Dunlap, C. F. Hemp-

stead, and Y. B. Kim (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 34: 3147-8(Oct. 1963).

A Nb_3Zr superconducting tube is used to produce magnetic field stabilization. To produce the stable field the working space is surrounded by the tube placed axially in the applied field. The applied field H is increased until the internal field H′ reaches the desired value, and then H is decreased to obtain a noncritical state. H′ remains constant as long as the tube remains superconducting and H does not change enough in either direction to return the tube to a critical state. (C.E.S.)

11112 INTERACTION ENERGY OF THE MIXTURES He^3–He^4. A CLASSICAL APPROACH. Masaji Onodera (Niigata Univ., Japan). Niigata Daigaku Kogakubu Kenkyu Hokoku, No. 12, 61-5(Mar. 1963). (In Japanese)

The theory of regular solutions through the asymptotic method lately found by the author is applied to mixtures He^3–He^4. The result of the calculation provides the following facts: (1) the value of the heat of mixing W in Heer and Daunt. (2) W decreases with increasing temperature, which is like the temperature behavior of W on Sommer's data of vapor pressures of mixtures and calculated by Henry's law, although their values are not accordant quantitatively with each other. (3) W depends on the structure of the mixtures through the number of nearest neighbors z. (auth)

11113 TRANSPORT CURRENTS IN TYPE-2-SUPERCONDUCTORS. W. Klose (Siemens-Schuckertwerke AG, Erlangen, Ger.). Phys. Letters, 8: 12(Jan. 1, 1964).

An attempt was made to separate a magnetization current part from the current distribution in the Ginzburg-Landau theory of a type-2 superconductor as given by Abriksov. The results indicate the impossibility of superposing transport current onto an Abriksov current distribution. Apparently the current carrying capacity is limited by H_{c1} rather than H_c ($H_{c1} < H_c < H_{c2}$) and may be smaller than in type-1 superconductors. (D.C.W.)

11114 DOES PARTIAL INEFFECTIVITY OF THE ENERGY GAP IN SUPERCONDUCTORS OCCUR UNDER THE INFLUENCE OF HIGH MAGNETIC FIELDS? C. J. Gorter, H. Van Beelen, and R. De Bruyn Ouboter (Kamerlingh Onnes Lab., Leiden). Phys. Letters, 8: 13(Jan. 1, 1964).

An examination of the Gibbs function of a type II superconductor as a function of the magnetic field for different field and temperature relations indicates that the energy gap is at least partially ineffective. (D.C.W.)

11115 QUENCHING OF METALS IN LIQUID HELIUM II—A NEW METHOD. L. Rinderer (Université, Lausanne, Switzerland) and H. Schultz. Phys. Letters, 8: 14-15 (Jan. 1, 1964). (In German)

A method is described that features high quenching speeds, quenching at 1.5°K and the possibility of determining the frozen-in defect concentration by measurement of the residual resistance, and extremely clean conditions that are comparable to those of ultra-high-vacuum techniques. The method is not suited to metals of high melting point but may be applied to some base metals such as gold and platinum. (R.E.U.)

11116 THE CRITICAL FIELD AT THE SURFACE OF A SUPERCONDUCTOR. G. Bon Mardion, B. B. Goodman, and A. Lacaze (Centre de Recherches sur les Très Basses Températures, Grenoble, France). Phys. Letters, 8: 15-17(Jan. 1, 1964). (In French)

Some experiments on the field dependence of surface superconductivity are discussed. Good agreement with theory on the critical field that re-establishes the normal state is noted. (D.C.W.)

11117 A PHASE TRANSITION AND ITS INFLUENCE ON SUPERCONDUCTIVITY IN THE (Nb,V)–Au A 15-TYPE STRUCTURE. E. Bucher, F. Laves, J. Muller, and H. Van Philipsborn (Swiss Federal Inst. of Tech., Zurich). Phys. Letters, 8: 27-8(Jan. 1, 1964).

Substitution of the Nb atoms in the Nb_3Au unit cell by V resulted in ternary solid solutions of the body-centered A2 type. Annealing at high temperatures transformed the Nb_3Au from the A2 phase to the A15 phase. Small amounts of the β Mn-type and tetragonal phases were also detected. The superconducting transition temperatures of the A15 and A2 phases were 11.0 and 1.2°K, respectively. The magnetic susceptibility of the A2 phase was about 50% lower than for the A15 phase. The temperature difference can be explained by different shapes of the d-band in the two phases. A similar transformation was observed in the V_3Au. (D.C.W.)

11118 THE TEMPERATURE DEPENDENCE OF THE PARAMAGNETICALLY LIMITED CRITICAL FIELD IN A SUPERCONDUCTOR OF THE SECOND KIND. J. A. Hulbert (Royal Radar Establishment, Malvern, Worcestershire, Eng.). Phys. Letters, 8: 34-5(Jan. 1, 1964).

The effect of the spin paramagnetism of the normal state on the temperature dependence of the upper critical field is examined in terms of a simple model. (D.C.W.)

11119 EVALUATION OF THE GINZBURG-LANDAU-ABRIKOSOV-GOR'KOV PARAMETERS FROM A NONLOCAL, NONLINEAR THEORETICAL MODEL. Arnold M. Toxen (IBM Watson Research Center, Yorktown Heights, N. Y.). Phys. Rev., 133: A1218-21(Mar. 2, 1964).

Expressions for the Ginzburg-Landau-Abrikosov-Gor'kov (GLAG) parameters such as the weak-field penetration depth δ_0, the dimensionless parameter κ, and the range of order parameter δ_0/κ were obtained from a simple, nonlocal, nonlinear theoretical model previously used to calculate the critical fields of superconducting films. It is shown that in the local limit, these expressions yield results that are in quite good agreement with those obtained by other techniques. Simple expressions were obtained for these parameters that are valid in the thin film limit. From these limiting formulas, it is apparent that κ can get large in thin films, and it is estimated that κ exceeds the critical value of $1/\sqrt{2}$ in indium films somewhat thinner than 1000 Å. It is concluded that in the thin limit, one would expect the order parameter to be nearly constant across the film thickness. (auth)

11120 BULK SOLUTION OF GINZBURG-LANDAU EQUATIONS FOR TYPE II SUPERCONDUCTORS: UPPER CRITICAL FIELD REGION. W. H. Kleiner, L. M. Roth, and S. H. Autler (Massachusetts Inst. of Tech., Lexington). Phys. Rev., 133: A1226-7(Mar. 2, 1964).

A solution is described of the Ginzburg-Landau equations of the Abrikosov type for a homogeneous type II superconductor just below the upper critical field. This solution is characterized by magnetic field maxima corresponding to an equilateral triangular lattice and a value $\beta = 1.16$ of Abrikosov's parameter. Abrikosov's square-lattice solution with $\beta = 1.18$ has a higher free energy and is unstable with respect to the triangular lattice solution. (auth)

11121 SURFACE BARRIER IN TYPE-II SUPERCONDUCTORS. C. P. Bean and J. D. Livingston (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev. Letters, 12: 14-16(Jan. 6, 1964).

The interaction between a flux thread (quantized, flux-enclosing, supercurrent vortex) and the specimen surface of a semi-infinite type-II superconductor with a flux thread within it lying parallel to the single plane surface is considered to determine any low-field hysteresis in the magnetization curves of well-annealed, single-phase specimens. (R.E.U.)

11122 NUCLEAR SPIN ORDERING IN ADSORBED He^3. Marcel H. Lambert (Univ. of California, Berkeley). Phys. Rev. Letters, 12: 67-8(Jan. 20, 1964).

Specific heat data on adsorbed He^3 at 0.1 to 1.4°K are presented. The results indicate that the nuclear spin entropy is substantially removed at 0.2°K and emphasize the importance of exchange effects at high densities. (R.E.U.)

11123 SUPERFLUID DYNAMICS IN THE HYDRODYNAMIC ($\omega\tau \ll 1$) AND COLLISIONLESS ($\omega\tau \gg 1$) DOMAINS. P. C. Hohenberg (Ecole Normale Superieure, Paris) and P. C. Martin. Phys. Rev. Letters, 12: 69-71 (Jan. 20, 1964).

A large stationary superfluid Bose system in thermal equilibrium is considered. An expression for the Fourier transform of the time-dependent correlation function is obtained. (R.E.U.)

11124 RESISTIVE TRANSITIONS AND SURFACE EFFECTS IN TYPE-II SUPERCONDUCTORS. C. F. Hempstead and Y. B. Kim (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Letters, 12: 145-8(Feb. 10, 1964).

Sheet samples of type-II superconductors were used to investigate resistive transitions in the mixed state. It is established that this phenomenon is basically a surface effect. Sheets of Nb–Ta and Pb–In alloys were investigated. (C.E.S.)

11125 EXPERIMENTAL EVIDENCE FOR A NEW SUPERCONDUCTING PHASE NUCLEATION FIELD IN TYPE-II SUPERCONDUCTORS. W. J. Tomasch (Atomics International, Canago Park, Calif.) and A. S. Joseph. Phys. Rev. Letters, 12: 148-50(Feb. 10, 1964).

Remnant superconductivity in thick films and bulk foils of Pb–Tl alloys was investigated in the field interval H_{c2} to $1.7 \times H_{c2}$, where H_{c2} is the bulk upper critical field. Measurements were made over the range 1.1–4.2°K. Two critical fields H_l (longitudinal) and H_t (transverse) which mark, respectively, the cessation of superconductivity with the field applied parallel and perpendicular to the plane of the specimen, were defined. The ratio H_l/H_t is essentially constant, independent of composition, thickness, and temperature and implies a basic effect rather than one caused by specimen defects. (C.E.S.)

11126 EFFECT OF A TEMPERATURE-DEPENDENT ENERGY GAP ON THE THERMODYNAMIC BEHAVIOR OF LIQUID HELIUM NEAR THE λ POINT. C. E. Chase (Université, Leiden). Physica, 29: 1397-1402(Dec. 1963).

The singularities in specific heat C_P and expansion coefficient α_P occurring at the λ transition of liquid helium can be related directly to the spectrum of elementary excitations by assuming an appropriate variation of the energy gap $\Delta(P,T)$. For this purpose the surface $\Delta(P,T)$ near the λ line is approximated by a cylindrical section with generator parallel to the λ line. The observed singularities can then be explained if the second derivatives $(\partial^2\Delta/\partial T^2)_P$, $(\partial^2\Delta/\partial T \partial P)$, and $(\partial^2\Delta/\partial P^2)_T$ have logarithmic singularities along the λ line, the first derivatives $(\partial\Delta/\partial T)_P$ and $(\partial\Delta/\partial P)_T$ remaining finite. The assumed shape of the surface $\Delta(P,T)$ imposes a relation between C_P and α_P identical to that obtained by applying a similar cylindrical approximation to the surface S(P,T). Fitting the model to the observed values of C_P near T_λ yields an expression for $(\partial^2\Delta/\partial T^2)_P$, which can be integrated twice to obtain $\Delta(T)$. The resulting values of $\Delta(T)$ agree well with experiment. (auth)

11127 APPARATUS FOR MEASURING CHARACTERISTICS OF SUPERCONDUCTING TUNNEL JUNCTIONS. J. S. Rogers, J. G. Adler, and S. B. Woods (Univ. of Alberta, Edmonton, Can.). Rev. Sci. Instr., 35: 208-13(Feb. 1964).

Much information about the density of electron states in a superconductor may be obtained using electron tunneling techniques. It is of particular interest to measure the normalized dynamic conductance of superconducting tunnel junctions as a function of applied voltage. This quantity is the ratio of the dynamic conductance $(di/dv)_s$ when one or both metallic members of the tunnel junction are in the superconducting state, to the dynamic conductance $(di/dv)_n$ when both members are normal. A new method was developed that enables measurements to be made of $(di/dv)_s/(di/dv)_n$ to a few parts in ten thousand. With this method only a bridge circuit, a galvanometer amplifier, and an oscilloscope are used. The galvanometer amplifier has a passband from d-c to a few cycles and an input noise voltage of about 3×10^{-8} rms v. The circuits of the bridge and amplifier are presented and analyzed. The operation of the circuits for measuring the characteristics of low resistance specimens ($\lesssim 500\Omega$) is described. (auth)

11128 INVESTIGATION OF SUPERCONDUCTING TIN BY THE TUNNEL EFFECT. N. V. Zavaritskii (Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 1839-49(Dec. 1963). (In Russian)

The gap width in the energy spectrum of electrons of superconducting tin is investigated by the tunnel effect method. Depending on the crystallographic orientation, the gap width changes between $2\Delta/kT_c = 2.7$ and $2\Delta/kT_c = 4.3$. The anisotropy of Δ is of a complex nature. Along with large regions (~15 angular degrees) in which Δ does not change by more than 2%, there are regions in which Δ sharply varies as much as ~20% over an interval of ~5°. It is suggested that the anisotropy of this type may be due to the structure of the Fermi bands in tin. (auth)

11129 MAGNETIC PROPERTIES OF SUPERCONDUCTORS WITH $1 \neq 0$ PAIRING. A THEORY OF THE KNIGHT SHIFT. I. A. Privorotskii. Zh. Eksperim. i Teor. Fiz., 45: 1960-6(Dec. 1963). (In Russian)

A theory of the Knight shift in superconductors is developed in which formation of pairs with nonzero angular momenta is taken into account. It is found that for pairing in the triplet state the Knight shift at T = 0 does not vanish. The theoretical predictions are in good agreement with the experimental data. (auth)

11130 CRITICAL CURRENT AND CRITICAL MAGNETIC FIELD OF SUPERCONDUCTORS. V. V. Shmidt (Baikov Inst. of Metallurgy, USSR). Zh. Eksperim. i Teor. Fiz., 45: 1992-2005(Dec. 1963). (In Russian)

Distribution of the critical current over the cross section of a superconductor and also its dependence on filament density and on the external magnetic field is investigated on the basis of the filamentary model of a superconductor in which the superconducting filaments are dislocation lines arising during plastic deformation of the metal or any other thin superconducting inclusions. Various orientations of the magnetic field relative to a superconductor of rectangular cross section are considered. (auth)

11131 MAGNETIC AND RESISTIVE TRANSITIONS OF SOME Mo–Re ALLOYS. R. D. Blaugher and W. C. H.

Joiner (Westinghouse Electric Corp., Pittsburgh). 12p. (CONF-301-22)

From International Conference on the Science of Superconductivity, Hamilton, N. Y., Aug. 1963.

Magnetic and resistive transitions of three single crystal specimens of Mo–Re were measured over an extended temperature range. The measurements show further confirmation of the general features of the GLAG Type II Superconductor. The lower critical field shows a T^2 temperature dependence. The upper critical field fits neither the Ginzburg nor the Gor'kov temperature dependence. Oscillations in the decreasing portion of the magnetization curve, a discrepancy between the field at which M = 0, and the field at which the onset of resistance occurs, reversibility in the magnetization curves, and the sharpness of field penetration are examined for each specimen and discussed with respect to crystal perfection. (auth)

11132 FINE STRUCTURE IN SUPERCONDUCTING AND OTHER ALLOYS, STUDIED BY ELECTRON MICROPROBE ANALYSIS. Christoph J. Raub, Christian A. Andersen, Gustaf O. Arrhenius, and Bernd T. Matthias (Univ. of California, La Jolla). 3p. (CONF-313-4)

From 2nd National Meeting of the Society for Applied Spectroscopy, San Diego, Calif., Oct. 1963.

Results on fine structure analyses of phases in As–Pd, Au–Ba, Rh–Zr, platinum alloys, and intermetallic compounds with β-tungsten structure are discussed. The electron microprobe technique is used to complement x-ray-diffraction analyses. (R.E.U.)

11133 FERROMAGNETISM AND INCIPIENT SUPERCONDUCTIVITY IN $CeRu_2$ + 7.3% $GdRu_2$ ALLOY. J. J. Drautman, C. J. Anderson, and R. Del Grosso (Malaker Labs., Inc., High Bridge, N. J.). 10p. (CONF-342-9)

From Conference on Magnetism and Materials, Atlantic City, Nov. 1963.

The susceptibility, magnetic moment, and resistivity of an alloy of $CeRu_2$ + 7.3% $GdRu_2$ prepared by arc melting were measured in the range 1.3 to 20°K. This alloy was previously reported to be both ferromagnetic and superconducting. The sample is weakly ferromagnetic, and undergoes a superconducting transition that reduces the positive susceptibility. The resistance becomes smaller at the transition temperature, but does not become zero. The transition temperature in zero field is in good agreement with that previously reported. (auth)

11134 CONSEQUENCES OF FLUXOID QUANTIZATION IN THE TRANSITIONS OF SUPERCONDUCTING FILMS. M. Tinkham (Univ. of California, Berkeley). 21p. (CONF-301-26)

From International Conference on the Science of Superconductivity, Hamilton, N. Y., Aug. 1963.

The quantization of London's fluxoid in units of $\varphi_0 = hc/2e$ follows from the Bohr-Sommerfeld quantum condition applied to electron pairs. In thick-walled superconducting cylinders, this leads to quantization of flux itself. Very near T_c flux quantization does not occur, but fluxoid quantization leads to the periodic variation of T_c with flux observed by Little and Parks. By means of Ginzburg-Landau theory, the maximum periodic depression is calculated. The result correctly predicts the order of magnitude and the effect of impurity. The theory also accounts for an aperiodic parabolic background shift in terms of finite wall thickness and possible misalignment. The critical field of a plane film in perpendicular magnetic field is also calculated. The result is equivalent to that of Abrikosov for the upper critical field of type II superconductors, also involving a regular array of vortices, each containing a quantum of flux. This result is in excellent agreement with data of Morris on thermal conductivity, data of Chang, Kinsel, and Serin on magnetization, data of Mercereau and Hunt on persistant currents, and data of White on microwave absorption, all on thin films. The latter measurements confirm the unusual angular dependence predicted for the transition field. A brief discussion is also given of the diamagnetic screening currents circulating around the entire film. These lead to irreversible effects, remanent moments, and a magnetic moment orders of magnitude larger than that associated with excluding flux from the volume of the film itself. These effects do not appear to affect the final transition field predicted by the theory. (auth)

11135 A MEASUREMENT OF SPIN WAVE DISPERSION IN MnF_2 AT 4.2°K. G. G. Low (Atomic Energy Research Establishment, Harwell, Berks, Eng.), A. Okazaki, R. W. H. Stevenson, and K. C. Turberfield. 5p. (CONF-342-11)

From Conference on Magnetism and Materials, Atlantic City, Nov. 1963.

Antiferromagnetic spin waves were observed in a single crystal of MnF_2 at 4.2°K by the inelastic scattering of neutrons. Measurements were carried out using a twin rotor time-of-flight spectrometer having a mean incident neutron wavelength of 3.00 Å and a resolution (half-width at half-height) of 0.06 Å. Spin waves were excited in the $\{010\}$ plane of the crystal and the dispersion plotted for propagation in the $\langle 100\rangle$ and $\langle 001\rangle$ directions. The observed dispersion curves can be accurately described by spin wave theory using the following values for the parameters concerned: $J_1 = 0.32$°K (ferromagnetic), $J_2 = -1.76$°K (antiferromagnetic), $|J_3| < 0.05$°K, and an anisotropy field at (zero wave vector) $H_A = 1.06$°K, where J_1 is the exchange coupling between nearest neighbors (in the $\langle 001\rangle$ direction), J_2 acts between next nearest neighbors ($\langle 111\rangle$ directions), and J_3 refers to third neighbor coupling (along the $\langle 100\rangle$ and $\langle 010\rangle$ directions). A small effect arising from the wave vector dependence of H_A was calculated and taken into account in the evaluation of these parameters. The values quoted are in excellent agreement with those predicted from measurements of perpendicular susceptibility, spin wave resonance, paramagnetic resonance in $(Mn,Zn)F_2$, and from paramagnetic neutron scattering at room temperature. (auth)

Neutron Physics

11136 (AEEW-R-311) THE REPRESENTATION OF ABSORBERS IN FINITE-DIFFERENCE DIFFUSION CODES. A. N. Buckler and J. G. Tyror (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1963. 43p.

A method of representing absorbers in finite difference codes using the analytical flux solution in the vicinity of the absorbers is presented. Taking an idealized reactor model, numerical comparisons are made between the finite difference eigenvalues and fluxes and results obtained from a purely analytical treatment of control rods in a reactor (the Codd-Rennie method). Encouraging agreement is obtained. (auth)

11137 (ANL-6797(p.2-14)) THEORY OF FUNDAMENTAL PROPERTIES OF THE NEUTRON. R. M. Thaler (Case Inst. of Tech., Cleveland).

The history of neutron knowledge is discussed. The various interactions that nucleons participate in are discussed, and the possible applications in nuclear research are cited. (R.E.U.)

11138 (ANL-6797(p.21-6)) PROPOSED EXPERIMENT TO OBSERVE n-n SCATTERING. C. O. Muehlhause (National Bureau of Standards, Washington, D. C.).

An arrangement is proposed to measure the neutron-neutron scattering cross section at thermal energies to yield the zero-energy neutron-neutron singlet scattering amplitude. The apparatus was proposed for the NBSR. (R.E.U.)

11139 (ANL-6797(p.30-4)) ACCELERATION OF FREE NEUTRONS UNDER GRAVITY. D. Paya, J. W. T. Dabbs, J. A. Harvey, and H. Horstmann (Oak Ridge National Lab., Tenn.).

An experiment, carried out in the 180-m evacuated flight path of ORR, is described for determining the gravitational acceleration of free neutrons. The transmission edges of a polycrystalline Be filter were used to select neutron velocity. The local value of g was found to be 979.7 cm/sec^2. (R.E.U.)

11140 (ANL-6797(p.35-44)) MEASUREMENT OF THE POLARIZATION OF THERMAL-NEUTRON BEAMS BY MAGNETIZED MIRRORS. M. T. Burgy, G. R. Ringo, S. Ketudat, P. Rice-Evans, and S. Barkan (Argonne National Lab., Ill.).

The method and apparatus used for the measurements are described. A double-mirror polarizer and double-mirror analyzer were used. The mirrors were 93% Co and 7% Fe. (R.E.U.)

11141 (ANL-6797(p.45-55)) THE MAGNETIC-MIRROR NEUTRON POLARIZER AT THE REACTOR "ISPRA 1." M. Forte (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy).

The method and apparatus used at Ispra 1 for producing a polarized neutron beam are described. The polarization is obtained by reflecting a slow-neutron beam on a magnetized Co–Fe mirror. High neutron intensity and small beam width are obtained. (R.E.U.)

11142 (ASD-TDR-63-89) THE SPM METHOD FOR NEUTRONS. R. Aronson and J. Heitner (TRG, Inc., Syosset, N. Y.). Apr. 1962. Contract AF33(616)-7732. 64p. (AD-403485)

The stochastic process method (SPM) was programmed for neutron problems, and the method was investigated both theoretically and numerically. The problem was analyzed sufficiently to determine proper source and interface conditions, as well as appropriate methods of treating scattering by hydrogen and inelastic scattering by heavy elements within the spirit of the method. The SPM equations with boundary conditions, a discussion of some of the results, and operating instructions for the IBM-7090 SPM code and the auxiliary input code GENUC are presented. (auth)

11143 (CEA-2374) PROGRAMME FORTRAN POUR LE CALCUL DES CORRECTIONS D'ABSORPTION ET DE DOUBLE DIFFUSION DANS LES MESURES DE SECTIONS EFFICACES POUR LES NEUTRONS RAPIDES PAR LA METHODE DE MONTE-CARLO. (The Fortran Program for the Calculation of the Absorption and Double Scattering Corrections in Cross-Section Measurements with Fast Neutrons Using the Monte-Carlo Method). B. Fernandez (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 11p.

A calculation for double scattering and absorption corrections in fast neutron scattering experiments using Monte-Carlo method is given. Application to cylindrical target is presented in FORTRAN symbolic language. (auth)

11144 (CONF-187-50) THE DIFFUSION OF FAST NEUTRONS. N. C. Francis, E. J. Brooks, and R. A. Watson (Knolls Atomic Power Lab., Schenectady, N. Y.). [1963]. Contract W-31-109-eng-52. 24p.

From American Nuclear Society Meeting, New York, Nov. 1963.

The use of the asymptotic solution to the one-velocity transport equation is considered. The angular distribution for fast neutron elastic scattering by heavy elements is discussed. An exponential angular distribution is assumed to simplify the decay length calculation. The diffusion length of 1 to 15 Mev neutrons in iron is calculated, as well as the vector flux angular dependence. The asymptotic solution for an arbitrary angular distribution of a plane δ-function source is also found. An isotropic source is investigated, and some applications of the model are examined. (auth)

11145 (GA-4812) NEUTRON SPECTRA IN GRAPHITE POISONED WITH SAMARIUM. R. G. Bardes, G. H. Houghton, D. E. Parks, and J. R. Beyster (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Dec. 13, 1963. Contract AT(04-3)-167. 18p. (CONF-187-49)

From American Nuclear Society Meeting, New York, Nov. 1963.

Some previous experimental and theoretical investigations of neutron scattering from graphite are reviewed, and some spectra obtained with poisoned graphite are presented and discussed. The spectra were measured in a Sa-poisoned graphite cube at 80, 300, and 600°K and in an assembly representing the core-reflector interface in a heavily poisoned graphite reactor. The spectra were calculated in adequate agreement with experiment. (D.C.W.)

11146 (HW-79054(p.4-11)) THE MODIFIED HEAVY GAS EQUATION AND GRAPHITE-MODERATED SYSTEMS. K. B. Stewart and C. W. Lindenmeier (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The validity of the modified gas equation for graphite moderators was investigated by comparing its solution for the neutron flux distribution with the solution for the infinite medium balance equation. The solutions were quite similar for U–graphite systems of practical concentration. The modified gas equation, however, gave inaccurate results for systems containing moderately large quantities of Pu^{239}. For U–graphite systems, the modified equation was considerably more accurate than the usual heavy gas equation. (D.C.W.)

11147 (HW-79054(p.12-20)) SCATTERING LAW FOR WATER. [PART] II. C. W. Lindenmeier (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The scattering law was calculated by an approximation method that treats two (rather than the usual one) resonances exactly. Comparison with the single resonance treatment revealed large areas of energy and momentum transfer where the single resonance treatment is inaccurate. For these regions, the two-resonance treatment gives results notably closer to the experimental results. (D.C.W.)

11148 (WAPD-T-1610) A METHOD FOR NUMERICAL SOLUTION OF THE NEUTRON DIFFUSION EQUATIONS

IN HEXAGONAL GEOMETRY WITH A VARIABLE SPATIAL MESH. A. A. Gonzalez and B. H. Ruth (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Nov. 1963. Contract AT-11-1-GEN-14. 16p. (CONF-187-51)

From American Nuclear Society Meeting, New York, Nov. 1963.

A mesh description technique that permits preparation of a computer program to solve the neutron diffusion equations in variable-mesh hexagonal geometry is discussed. The key concept, which could be employed in other geometries, is to specify by conventional means the internal details of each of several basic figures having interfaces in only two directions, then create final figures in the entire problem layout by translation, rotation, and, perhaps, reflection of these basic figures. The problem outline (illustrated) of the entire solution region permits bent sweep lines of constant length so that 120° periodicity may be obtained easily, and the Ritz method difference equations permit the implementation of the mesh description concept for a completely variable hexagonal mesh. The running time for the resulting code are comparable with those for rectangular geometry for the same number of points. (auth)

11149 ON THE FERMI APPROXIMATION IN THERMAL NEUTRON SCATTERING. G. C. Summerfield (Univ. of Michigan, Ann Arbor). Ann. Phys. (N. Y.), 26: 72-80 (Jan. 1964).

The Fermi approximation and all higher order corrections are derived for the cross section for thermal neutron scattering from aggregates of atoms. The first order correction is shown to reduce to the result obtained by Lippmann and Schwinger in the special case that the scatterer is a single bound proton. The magnitude of the correction is estimated for an arbitrary number of scattering atoms, and it is shown to be approximately proportional to the inverse of the separation between atoms. (auth)

11150 CALCULATION OF A NEUTRON SPIN ROTATOR. Yu. V. Taran. At. Energ. (USSR), 15: 413-14 (Nov. 1963). (In Russian)

In several experiments with polarized thermal and resonance neutrons it was found necessary to change adiabatically the direction of the vector of the neutron beam polarization with respect to another direction, such as that of the nuclear polarization vector. The device which effectuates this change, usually by means of a rotating magnetic field, is called the spin rotator. The frequency of the Larmor precession of the neutron's magnetic moment ω_L must be larger than the frequency of the magnetic field ω_θ; thus $\omega_L = \omega_\theta$, whereby $k \gg 1$. In order to determine the value of this coefficient k, the behavior of the spin of a neutron within the rotating magnetic field is examined. It is shown that the value of ω_θ is related to the velocity by means of an expression containing the length of the spin rotator. It was found that at $k > 10$, neutrons having a velocity smaller than a given critical value change adiabatically the direction of their polarization by 180° without depolarization. (TTT)

11151 A THEORETICAL APPROACH TO THE NEUTRON MULTIPLICATION EXPERIMENTS INVOLVING A SINGLE FUEL ELEMENT. PART 2. S. E. Corno (AGIP Nucleare, San Donato Milanese, Milan). Energie Nucl. (Milan), 10: 653-70(Dec. 1963). (In Italian)

Physical interpretation of the theory referring to single fuel element neutron multiplication experiments is presented. The purpose was to provide theoretical insight for establishing procedures that allow measurements of neutron absorption and multiplication parameters to be made independently of one another. (auth)

11152 SCATTERING OF SLOW NEUTRONS ON CRYSTALS AND SOLIDS. [PART] I. B. R. A. Nijboer and J. J. J. Kokkedee (Instituut voor Theoretische Fysica, Utrecht). Ned. Tijdschr. Natuurk., 29: 61-79(Mar. 1963). (In Dutch)

The scattering of thermal neutrons on crystals and solids is considered from the theoretical aspect. The scattering on a free nucleus, scattering on a macroscopic system in the static approximation, crystal dynamics and diffuse scattering, and dynamic theory of neutron scattering on harmonic crystals are discussed. (J.S.R.)

11153 THE EFFECTS OF COHERENT SCATTERING OF THE THERMALIZATION OF NEUTRONS IN BERYLLIUM. R. R. Fullwood, R. E. Slovacek, and E. R. Gaertner (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Sci. Eng., 18: 138-40(Jan. 1964).

The effects of coherent neutron scattering on the neutron spectrum in finite assemblies were investigated. Data on the time-dependent spectra in beryllium at 30°C were obtained by the phased-neutron-chopper/linear-electron-accelerator technique. Prominent crystalline effects were observed at Bragg energies of 0.022 and 0.0067 ev. (C.E.S.)

11154 REMARK TO THE SOLUTION OF THE NEUTRON TRANSPORT EQUATION. S. Depken (Royal Inst. of Tech., Stockholm). Nuovo Cimento (10), 31: 7-9(Jan. 1, 1964).

The velocity-space distribution of neutrons from a point source is investigated. The main difficulty of this problem is stated, and then it is indicated how it can be overcome. (auth)

11155 ON THE USE OF CASE'S GENERAL SOLUTION OF THE TRANSPORT EQUATION IN NEUTRON TRANSPORT PROBLEMS. S. Gallone (Politecnico, Milan) and G. Ghilardotti. Nuovo Cimento (10), 31: 203-18(Jan. 1, 1964).

Case's general solution of the one-velocity transport equation is applied to the limiting behavior of the asymptotic flux in a noncapturing medium, Milne's problem and extrapolation distance, and connection at an interface of asymptotic flux and current. Case's general solution is then compared with that obtained by the P_L approximation. An extension is given to the case of anisotropic scattering. (auth)

11156 A STUDENT EXPERIMENT IN MEASURING NEUTRON FLUX BY FOIL ACTIVATION. Francis J. Jankowski (Rutgers Univ., New Brunswick, N. J.). Res. Reactor J., 4: 23-6(1963).

An experiment is described that involves using neutrons to activate a stack of thin foils that simulates a thick foil, counting the individual thin foils, obtaining beta absorption and reflection curves, and then synthesizing a value for the thick-foil activity to compare to the actual measurement of this activity. (R.E.U.)

11157 ON NEUTRON TOTAL REFLECTION FROM COBALT MIRRORS. S. Ripeanu, M. Popovich, B. Grabchev, and V. Vasiliu (Inst. of Nuclear Physics, Bucharest). Rev. Phys., Acad. Rep. Populaire Roumaine, 8: 277-84 (1963). (In Russian)

A monochromatic neutron beam was used for measuring parameters of several (~10μ) cobalt mirrors. The beam reflection coefficient was measured as a function of the angle of beam incident and of magnetizing field. (R.V.J.)

11158 CRITICAL MAGNETIC SCATTERING OF NEUTRONS IN IRON. L. Passell (Research Establishment Risø, Roskilde, Denmark), K. Blinowski, T. Brun, and P. Nielsen. 9p. (CONF-342-13)

From Conference on Magnetism and Materials, Atlantic City, Nov. 1963.

The intense small-angle scattering of low-energy neutrons by magnetic materials in the neighborhood of the Curie temperature was previously shown to be directly related to the appearance of large-scale fluctuations in the spin density. The angular and energy distribution of 427-Å neutrons scattered at small angles in iron were measured and the spin correlation range and a parameter associated with the lifetime of the fluctuations were determined. Results confirm recent observations that the scattering is not elastic even at the Curie temperature. (auth)

11159 METHOD OF PRODUCING NEUTRONS. Donald H. Imhoff and W. H. Harker (to U. S. Atomic Energy Commission). U. S. Patent 3,120,470. Feb. 4, 1964.

A method for producing neutrons is described in which there is employed a confinement zone defined between longitudinally spaced localized gradient regions of an elongated magnetic field. Charged particles and neutralizing electrons, more specifically deuterons and tritons and neutralizing electrons, are injected into the confinement field from ion sources located outside the field. The rotational energy of the particles is increased at the gradients by imposing an oscillating transverse electrical field thereacross. The imposition of such oscillating transverse electrical fields improves the reflection capability of such gradient fields so that the reactive particles are retained more effectively within the zone. With the attainment of appropriate densities of plasma particles and provided that such particles are at a sufficiently high temperature, neutron-producing reactions ensue and large quantities of neutrons emerge from the containment zone. (AEC)

Nuclear Properties and Reactions

Refer also to abstracts 10425, 10702, and 10703.

11160 (ANL-6797(p.58-78)) APPLICATIONS OF NUCLEAR MODELS TO LOW-LYING STATES—SUMMARIES AND DEVELOPMENTS. Steven Moszkowski (California. Univ., Los Angeles).

The effects of pairing on electromagnetic transitions, some aspects of nuclear vibrational states including the coupling of an odd particle to a vibrating core, and the limitations of the shell model and the presence of strong collective motion in some light nuclei are discussed. (R.E.U.)

11161 (ANL-6797(p.79-88)) CAPTURE GAMMA DETERMINATION OF VANADIUM-52 STRUCTURE. D. H. White, W. John, and B. G. Saunders (California. Univ., Livermore. Lawrence Radiation Lab.).

A bent-crystal spectrometer was used to study the spin structure of V^{52} from capture gammas. Correlation and coincidence measurements were carried out, and the level scheme of V^{52} is proposed. (R.E.U.)

11162 (ANL-6797(p.89-110)) ROTATIONAL AND VIBRATIONAL EFFECTS IN NEUTRON-CAPTURE GAMMA-RAY SPECTRA. R. K. Smither (Argonne National Lab., Ill.).

Some aspects of observed capture-gamma spectra, which appear to be common to many nuclei, are discussed and attributed to the collective and statistical properties of the nuclei. Eight nuclei were studied by (n,γ) reactions; the excited nucleus and its basic classification, the character of its ground state, and general properties of its level scheme are discussed. The Argonne bent-crystal spectrometer was used to study (n,γ) reactions with Hf^{177}, Hf^{179}, Sm^{152}, Sm^{151}, Sm^{150}, Sm^{149}, Te^{123}, and Cd^{113}. (R.E.U.)

11163 (ANL-6797(p.133-42)) CAPTURE GAMMA RAYS FROM DYSPROSIUM. H. T. Motz and R. E. Carter (Los Alamos Scientific Lab., N. Mex.).

The Los Alamos Compton spectrometer was used to study the gamma-ray spectrum from $Dy^{164}(n,\gamma)Dy^{165}$. The level scheme of Dy^{165} and the assumed spin of a 1.2-min isomer of 108 kev in Dy^{165} were studied. A comparison is made between (n,γ) and (d,p) reactions with Dy^{164}. (R.E.U.)

11164 (ANL-6797(p.143-7)) BENT-CRYSTAL MEASUREMENTS ON GAMMA RAYS FROM NEUTRON CAPTURE IN INDIUM. W. John and R. W. Jewell (California. Univ., Livermore. Lawrence Radiation Lab.).

A 2-m bent-quartz-crystal spectrometer was used to measure the energies, from 85 to 1300 kev, of the gamma rays emitted by an indium target exposed to reactor neutrons. The spectrometer layout and data acquisition are described. (R.E.U.)

11165 (ANL-6797(p.148-55)) INVESTIGATION OF NEUTRON CAPTURE IN SAMARIUM USING A HIGH-RESOLUTION CONVERSION-ELECTRON SPECTROMETER. E. Bieber (Munich. Technische Hochschule).

A high-resolution spectrometer utilizing conversion electrons is described and applied to neutron capture in samarium-150. (R.E.U.)

11166 (ANL-6797(p.179-82)) CAPTURE GAMMA RAYS AND NEUTRON BINDING ENERGIES. R. E. Carter and H. T. Motz (Los Alamos Scientific Lab., N. Mex.).

An iron-core double-focusing spectrometer was used to determine stop-over and cross-over transitions in Be^{10}, C^{13}, and N^{15}. The neutron binding energies are obtained from these data. (R.E.U.)

11167 (ANL-6797(p.194-210)) THE COLLECTIVE MODEL IN RELATION TO NEUTRON-CAPTURE GAMMA-RAY SPECTRA. D. M. Brink (Oxford Univ. Clarendon Lab.).

Estimates of partial radiation widths for electric- and magnetic-dipole and electric-quadrupole transition gamma rays following neutron capture are discussed. Other transitions are also discussed. (R.E.U.)

11168 (ANL-6797(p.211-19)) PARTIAL WIDTHS FOR E1 GAMMA RAYS FROM NEUTRON RESONANCES AND THEIR RELATION TO THE GIANT RESONANCE. R. T. Carpenter (Iowa. State Univ., Iowa City).

A survey is presented of existing experimental knowledge of E1 transition probabilities involving states near the neutron binding energy. Measurements of gamma spectra following thermal neutron capture are reviewed. (R.E.U.)

11169 (ANL-6797(p.220-9)) NEUTRON-CAPTURE GAMMA-RAY SPECTRA AND THE M1 GIANT RESONANCE. I. Bergqvist, B. Lundberg, and N. Starfelt (Sweden. Forsvarets Forskningsanstalt, Stockholm).

It is suggested that M1 transitions may compete successfully with E1 transitions in the mass regions $110 \leq A \leq 140$ and $180 \leq A \leq 200$ because of the effect of a predicted M1 giant resonance. Gross structure of gamma spectra in these regions is shown. Measurements are given for gamma spectra from the capture of neutrons at 1 and 3.2 Mev in Au and Ta. (R.E.U.)

11170 (ANL-6797(p.230-5)) GAMMA-RAY SPECTRA FROM RESONANCE NEUTRON CAPTURE IN THE TIN ISOTOPES. J. A. Harvey, G. G. Slaughter, J. R. Bird, and G. T. Chapman (Oak Ridge National Lab., Tenn.).

A NaI crystal was used to study gamma spectra from neutron capture in individual resonances in enriched 90 to 98% samples. A 5-m flight path was used with the ORR fast-chopper spectrometer, resulting in a neutron energy resolution width of 15% up to 200 ev. Results are given for seven abundant isotopes. Thermal neutron-capture gamma spectra were also studied. (R.E.U.)

11171 (ANL-6797(p.243-6)) STUDY OF THE NEUTRON-CAPTURE GAMMA RAYS IN Ca^{48}. Sol Raboy and C. C. Trail (Argonne National Lab., Ill.).

The apparatus and method are discussed for studying gamma rays from neutron capture by nuclei of low cross section and/or by samples containing only small numbers of atoms of interest. Results are given for $Ca^{48}(n,\gamma)Ca^{49}$. (R.E.U.)

11172 (ANL-6797(p.247-58)) NEUTRON CAPTURE BY DEUTERIUM. C. C. Trail and S. Raboy (Argonne National Lab., Ill.).

The yield of the capture gamma rays was measured as a function of the polarization of the incident neutron beam. The capture cross section and gamma-ray energy were studied. (R.E.U.)

11173 (ANL-6797(p.270)) GAMMA-RAY ANGULAR CORRELATIONS IN Ca^{45}, Fe^{55}, Ni^{59}, Ni^{61}, AND Ni^{63}. R. E. Coté, H. E. Jackson, Jr., L. L. Lee, Jr., and J. P. Schiffer (Argonne National Lab., Ill.).

Parity and spin assignments are made to a total of nine $l = 1$ levels in Ca^{45}, Fe^{55}, Ni^{59}, Ni^{61}, and Ni^{63}. (R.E.U.)

11174 (ANL-6797(p.271-4)) VARYING THE ENERGY OF NEUTRON-CAPTURE GAMMA RAYS. G. Ben-David, B. Arad, and I. Pelah (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth).

The effects of thermal Doppler broadening on source and resonance line widths in resonant scattering of thermal-neutron-capture gamma rays are discussed. The Doppler energy shift was studied for the 7.28-Mev resonance in lead using a rotating target. (R.E.U.)

11175 (ANL-6797(p.275-87)) NUCLEAR RESONANT SCATTERING OF THERMAL-NEUTRON-CAPTURE GAMMA RAYS. B. Arad, G. Ben-David, I. Pelah, and Y. Schlesinger (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth).

A monoenergetic source of capture gamma rays, the width determined by thermal Doppler broadening, of the order of a few ev at normal temperatures is used to investigate individual levels in the energy region just below the particle threshold. Fifty resonances were found in twelve capture-gamma-ray sources and 51 scattering targets; the sources were 6 to 9 Mev and the scattering targets were $11 \leq Z \leq 92$. (R.E.U.)

11176 (ANL-6797(p.288-93)) MEASUREMENT OF (γ,n) CROSS SECTIONS WITH NEUTRON-CAPTURE GAMMA RAYS. L. Green, R. R. Hurst (Pennsylvania State Univ., University Park), and D. J. Donahue (Arizona. Univ., Tucson).

The method and results are given for (γ,n) reactions with C^{13}, Li^{6}, and Ta^{181}. The cross section dependence on mass number A is shown for 10.8-Mev gammas. (R.E.U.)

11177 (ANL-6797(p.294-300)) TOTAL RADIATION WIDTHS FOR s-WAVE AND p-WAVE NEUTRON CAPTURE IN Nb^{93}. H. E. Jackson (Argonne National Lab., Ill.).

The relative values of the s- and p-wave widths were determined for six resonances in Nb^{93}. (R.E.U.)

11178 (ANL-6797(p.302-21)) STATISTICAL PROPERTIES OF NUCLEAR STATES AND TRANSITIONS. Norbert Rosenzweig (Argonne National Lab., Ill.).

The statistical theory of neutron resonances is discussed. It is pointed out that the random-matrix model, due to E. P. Wigner, leads to a theory of both the energy-level fluctuations and the distribution of widths. The properties and limitations of the model are discussed. (23 references) (R.E.U.)

11179 (ANL-6797(p.322-3)) DISTRIBUTION OF PARTIAL RADIATION WIDTHS. L. M. Bollinger, R. E. Coté, R. T. Carpenter, and J. P. Marion (Argonne National Lab., Ill.).

A least-squares fitting of the gamma spectra from resonance neutron capture in Hg^{199}, Pt^{195}, W^{183}, and Se^{77} for relative values of partial widths for various sets of high-energy radiative transitions is reported. (R.E.U.)

11180 (ANL-6797(p.324-32)) RESONANCE NEUTRON COINCIDENCE CAPTURE GAMMA-RAY SPECTRA IN W^{184}. J. A. Moore, J. L. Friedes, R. E. Chrien, and H. Palevsky (Brookhaven National Lab., Upton, N. Y.).

The system used with the NRU reactor for the measurement of resonance neutron coincidence capture gamma rays is described. Data are given for W^{184} spectra. (R.E.U.)

11181 (ANL-6797(p.333-41)) FLUCTUATIONS IN PARTIAL RADIATION WIDTHS OF U^{239}. H. E. Jackson (Argonne National Lab., Ill.).

The partial radiation widths for transitions from neutron resonances of given spin and parity to a definite final state were measured for transitions between 3.9 and 4.2 Mev and resonances between 6.7 and 240 ev in U^{239}. The experimental apparatus is described. The E1 anomaly in the 4.06-Mev transition observed in the thermal capture of U^{238} was studied. (R.E.U.)

11182 (ANL-6797(p.342-57)) RESONANCE REACTIONS AND THE NUCLEAR SHELL MODEL. R. H. Lemmer (Massachusetts Inst. of Tech., Cambridge).

The transition matrix for nucleon–nucleus elastic scattering is obtained using a unified theory of nuclear reactions developed by H. Feshback. The scattering of low-energy nucleons by N^{15}, leading to compound states of N^{16} or O^{16}, is discussed using shell-model representation for N^{15}. The structure of cross-section calculations is given. The calculated resonance energies and widths obtained using a particle-hole description for N^{16} are given. (R.E.U.)

11183 (ANL-6797(p.363-8)) SPIN OF SOME LOW-ENERGY NEUTRON RESONANCES BY RESONANCE SCATTERING. F. Poortmans and H. Ceulemans (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium):

Results are given for Γ_n/Γ for low-energy neutron resonances in Sm^{149}, Sm^{147}, Ir^{193}, and Gd^{157}. The spin values are deduced. (R.E.U.)

11184 (ANL-6797(p.369-75)) SMALL-SAMPLE TRANSMISSION MEASUREMENTS ON Pu^{241}, USING AN ELECTRON-LINAC PULSED-NEUTRON-SOURCE TIME-OF-FLIGHT SPECTROMETER. N. J. Pattenden and S. Bardsley (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The advantages of pulsed accelerators as neutron sources for slow-neutron time-of-flight spectrometers above a few hundred ev are discussed. Samples of PuO_2 (94% enrichment of Pu^{241}) were subjected to transmission

measurements. The observed total cross sections per PuO_2 molecule from 3 to 5000 ev are given. (R.E.U.)

11185 (ANL-6797(p.384-7)) SLOW-NEUTRON CROSS SECTION OF He^3, B, AND Au; AND A He^3 PROPORTIONAL COUNTER FOR THE ABSOLUTE DETERMINATION OF NEUTRON BEAM INTENSITY. J. Als-Nielsen, A. Bahnsen, and O. Dietrich (Denmark. Atomenergikommissionen. Forsøginstitut, Risø).

A method using He^3 for neutron-beam density measurements is described. Total energy-dependent neutron cross sections are given for He^3 and Au, and absorption cross sections are given for B and Au. (R.E.U.)

11186 (ANL-6797(p.388)) RADIOMETRIC DETERMINATION OF THE NEUTRON-CAPTURE CROSS SECTION OF 35-HR Rh^{105}. L. E. Glendenin, H. C. Griffin (Argonne National Lab., Ill.); and R. A. Schmitt (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

The activation cross section for capture of reactor neutrons by 35-hr Rh^{105} was measured by radiometric assay of induced activities of 30-sec Rh^{106} and 2.2-hr Rh^{106}. (R.E.U.)

11187 (ANL-6797(p.389-92)) ANGULAR DISTRIBUTION OF GAMMA RAYS FROM $(n,n'\gamma)$ REACTIONS PRODUCED BY FAST NEUTRONS FROM A REACTOR. R. D. Roberts (Pennsylvania State Univ., University Park); and D. J. Donahue (Arizona. Univ., Tucson).

Experiments were performed to see if a reactor could be used as a source of neutrons for the study of angular distributions of gamma rays from inelastic scattering events. Results are given for $Pb^{208}(n,n'\gamma)$ and $Mg^{24}(n,n'\gamma)$, and also for transitions in Fe^{56}. (R.E.U.)

11188 (ANL-6797(p.397-403)) NMR OF SHORT-LIVED NUCLIDES BY POLARIZED NEUTRON CAPTURE AND β-DECAY ANISOTROPY. D. W. Connor, T. Tsang, and D. L. Davis (Argonne National Lab., Ill.).

Nuclear polarization resulting from the capture of polarized neutrons is discussed. The relaxation processes that tend to destroy the nuclear polarization, the spatial anisotropy of β-particle emission from polarized nuclei, and the experimental techniques used are described. The application of this method to NMR techniques and its advantages is discussed. NMR asymmetry data are given for F^{20} in a CaF_2 single crystal. (R.E.U.)

11189 (ANL-6797(p.424-37)) EXPERIMENTS ON FISSION USING THERMAL NEUTRONS. H. Maier-Leibnitz (Munich. Technische Hochschule).

The possibilities and limits in gaining complete experimental data on thermal-neutron fission processes in samples are considered. Mass and energy distributions of fission fragments are discussed, and results are given for U^{235}, U^{233}, Pu^{239}, and Cf^{252}. Charge distributions and excitation energies of primary and secondary fission fragments are considered. (R.E.U.)

11190 (ANL-6797(p.441-8)) CORRELATED FRAGMENT-ENERGY MEASUREMENTS FOR LOW-ENERGY NEUTRON-INDUCED FISSION. F. J. Walter, H. W. Schmitt, and J. H. Neiler (Oak Ridge National Lab., Tenn.).

The source-detector-vacuum chamber arrangement is described. The reduction of data to contour diagrams representing correlated fragment energies for thermal-neutron fission is discussed. Energy and mass distributions are given for binary fission of U^{235}, Pu^{239}, and Pu^{241}, and three-particle fission of U^{235}. (R.E.U.)

11191 (ANL-6797(p.455-63)) NEW METHOD FOR THE DETECTION OF SHORT-LIVED FISSION PRODUCTS. D. Hovestadt and P. Armbruster (Munich. Technische Hochschule).

Mass spectrometric separation methods for short-lived fission products are described. Separation time is about 1 μsec. The design and calibration of a device using such a method are discussed. The Q value of $Sr^{94} \rightarrow Y^{94}$ decay was measured using $\beta-\gamma$ spectrum analysis. (R.E.U.)

11192 (BAW-1286) RESONANCE ABSORPTION IN THORIUM METAL AND OXIDE RODS. Final Report. W. G. Pettus, M. N. Baldwin, and C. Samuel (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Nov. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-3125. 81p. (EURAEC-967)

Measurements of the resonance capture integral and associated phenomena for Th and ThO_2 rods were made using primarily an activation technique. The geometrical and temperature dependence of the effective resonance integral of ThO_2 rods was determined. The treatment of Dancoff and Ginsburg to account for the mutual shielding of parallel rods was confirmed by direct measurements on ThO_2 and UO_2 rods. (auth)

11193 (CONF-250-18) OXYGEN-17 NUCLEAR MAGNETIC RESONANCE IN PARAMAGNETIC MnO AND CoO. D. E. O'Reilly and Tung Tsang (Argonne National Lab., Ill.). [1963]. Contract [W-31-109-eng-38]. 12p.

From American Physical Society 1963 Summer Meeting in the West, Edmonton, Can., August 1963.

A nuclear magnetic resonance study of O^{17} resonance in paramagnetic MnO and CoO is reported. The internal fields at the oxygen nuclei were measured. Interpretation of the measured fields showed that the spin densities in the oxygen 2s orbitals were 0.76% for MnO and 0.66% for CoO. Nuclear relaxation times were also measured and compared with Moriya's theory. (auth)

11194 (CONF-346-7) DIRECT AND ABSOLUTE MEASUREMENT OF AVERAGE YIELD OF NEUTRONS FROM THERMAL FISSION OF U^{235}. A. De Volpi and K. Porges (Argonne National Lab., Ill.). [1962]. Contract [W-31-109-eng-38]. 5p.

From International Conference on Nuclear Physics with Reactor Neutrons, Argonne, Ill., Oct. 1963.

Apparatus and procedures with which the average yield is to be determined directly with a planned accuracy of 1% are described. (D.C.W.)

11195 (EANDC(E)-49(L)) PROGRESS REPORT ON NUCLEAR DATA RESEARCH IN THE EURATOM COMMUNITY. J. Spaepen (European-American Nuclear Data Committee). Oct. 1963. 147p.

Research progress in neutron physics, nuclear structure, nuclear physics, reactor physics, criticality, isotopic standards, and associated areas is summarized. Developments in equipment are also covered. (D.C.W.)

11196 (HW-79054(p.64-81)) THREE CALCULATIONS RELATED TO THE MEASUREMENT OF TOTAL CROSS SECTIONS. D. G. Foster, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Some calculations preliminary to the measurement of total cross sections for fast neutrons by the conventional transmission technique are reported. (D.C.W.)

11197 (IITRI-A6027-9) STUDIES OF THE RESONANCE INTEGRALS OF Re AND Tm. Quarterly Progress Report, October 1, 1963–December 31, 1963. G. Hardie, W. E. Loewe, and W. E. Zagotta (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Jan. 13, 1964. Contract AT(11-1)-578. 38p.

The measurements for the activation experiment to determine the infinitely dilute resonance integral of thulium were completed, and most of the effort was devoted to data analysis. The presence of a small amount of Ta background in the Tm gamma spectrum complicated the correction to be count rate for residual background. A plan was developed to measure the sensitivity of the IITRI reactor for danger coefficient measurements. A gear box to reduce the control rod speed was installed, and a bucking circuit was developed to permit accurate observation of very small excess reactivities. Additionally, a FORTRAN program was written for the IBM 7090 to calculate the effect of crystalline binding on the resonance integral of rhenium. (D.C.W.)

11198 (JINR-P-1222) ZAMECHANIE O VLIYANII VNESHNIKH POLEI NA KVANTOVYE UROVNI ATOMOV I YADER. (On Effect of External Fields on Quantum Levels of Atoms and Nuclei). L. Zastavenko and M. Podgoretskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1963. 7p.

The combined effect of the magnetic and electric fields (or quadrupole splitting) on the structure of quantum levels and on the properties of successive electromagnetic transitions was investigated. Specific phenomena due to the transverse magnetic field were considered. (auth)

11199 (JINR-P-1445) O CHISLENNOM RESHENII NEREGULYARIZOVANNYKH URAVNENII LOU. (On the Numerical Resolution for Non-regularized Low Equations). I. P. Nedyalkov and G. I. Penchev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1963. 12p.

A direct numerical solution, free of N/D and Chew-Low-Salzman shortcomings, was developed for the non-regularized Low equations. The solution is somewhat slower than the N/D or Chew-Low-Salzman methods but it is preferable because there is no proof that the N/D and Chew-Low-Salzman methods do not introduce incorrect asymptotic behavior in the $g_2(\omega)$ function. (R.V.J.)

11200 (JINR-P-1452) MEKHANIZM OBRAZOVANIYA I VZAIMODEISTVIYA CHASTITS V YADRE UGLERODA. (On a Mechanism of Particle Production and Interaction in the Carbon Nucleus). V. A. Belyakov, A. V. Boyadzhiev, N. M. Viryasov, and V. M. Alatsev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1963. 24p.

The intranuclear cascades induced by fast π^- mesons in carbon are considered. The results of the calculations by the Monte-Carlo method are compared with the experimental data. A good fit between calculation and experiment was obtained for the spectra of mesons(K), hyperons, mesons(π) and nucleons produced as a result of a cascade. The schemes of the cascades for hyperons(Λ) and mesons (K) are given. It is shown that the cascade model of the interaction is in satisfactory agreement with experiment. On the basis of the calculated meson(π^0) spectrum, an attempt is made to single out the sources of γ-quanta other than the channel $\pi^0 \rightarrow 2\gamma$. (auth)

11201 (JINR-P-1456) POISKI INTERFERENTSII REZONANSNOGO ZAKHVATA NEITRONOV S POTENTSIAL'NYM V REZONANSE ZOLOTA 4,9 ev. (Search for the Interference of the Resonance Neutron Capture With the Potential One in the Gold Resonance of 4.9 ev). D. Dorchoman, B. Kardon, D. Kiss (Kish), and G. S. Samosvat (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1963. 12p.

An attempt was made to find interference of resonance neutron capture with potential capture. The capture cross sections measured in recording the different sections of the hard component of the gamma spectra from the reaction $Au^{197}(n,\gamma)Au^{198}$, were compared with that measured in recording the middle part of the same spectrum. Within the errors the interference was not found. The magnitude of the potential capture cross section at the resonance energy is estimated to be <0.5 mb, which was obtained under the assumption that the direct capture mechanism is displayed in the irradiation of all the gamma lines with an energy of 5.5 to 6.5 Mev. (auth)

11202 (JINR-P-1464) IZUCHENIE REAKTSII $(p,p\pi^+)$ NA In^{115}. (A Study of the Reaction $(p,p\pi^+)$ on In^{115}). N. S. Mal'tseva and V. N. Rybakov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1963. 10p.

The excitation function for the reaction $(p,p\pi^+)$ on In^{115} was obtained for proton energies of 130 to 660 Mev. The total cross section for the reaction at 660 Mev was determined to be $0.142 \pm 0.034 \times 10^{-27}$ cm^2. The results are compared with theoretical calculations, as well as with the data for the reaction on other nuclei in the same energy range. (auth)

11203 (LNF-63/47(p.41-5)) 1. STUDIO PRELIMINARE DI UNA ESPERIENZA (e,e'p). (I. Preliminary Study of a (e,e'p) Experiment). U. Amaldi (Italy. Istituto Superiore di Sanità, Rome).

The feasibility of a (e,e'p) experiment to study the internal structure of nuclei with A < 60 is discussed by first considering the principal of the method. A possible experimental device for such an experiment with the $C^{12}(e,e'p)B^{11}$ reaction is discussed. It is shown that the experiment is feasible from the point of view of intensity with the use of the Frascati electrosynchrotron. The problems of energy and angle resolution would be serious, but probably would be soluble. The success of such a study would depend essentially on the particle background in the toroid. The energy and angular resolutions possible are determined. (J.S.R.)

11204 (LNF-63/47(p.46-9)) 2. PROGETTO PRELIMINARE DI UNA ESPERIENZA (e,e'γ) CON RIVELAZIONE DEL γ DI DISECCITAZIONE DEL NUCLEO. (II. Preliminary Project of a (e,e'γ) Experiment with Detection of the De-Excitation γ of the Nucleus). U. Amaldi (Italy. Istituto Superiore di Sanità, Rome).

A preliminary project for the inelastic scattering of electrons using the internal beam of the Frascati electrosynchrotron is presented. The processes to be studied are the excitation with electrons of various level by detecting in coincidence the inelastically scattered electron and the γ quantum emitted by the nucleus in its de-excitation. A scattering angle of 30° was selected for the final electron and the incident electron energy chosen varied between 200 and 600 Mev. The velocity counting for Be^9, C^{12}, and O^{18} at various transfer moments was estimated using electrical transfer cross sections reported in the literature. The coincidence background was also estimated. (J.S.R.)

11205 (LNF-63/47(p.91-4)) PROGRAMMA DI RICERCA DEL GRUPPO NAPOLI-PAVIA. (Research Program of the Napoli-Pavia Group). P. E. Argan and G. Piazzoli.

The Napoli-Pavia group is investigating the photoproduction of pions on complex nuclei with the double purpose of obtaining data on new nuclear levels, unob-

tainable with other methods, and determining the mechanism for the photoproduction of pions on nuclei. A study of the n^4 level in He^4 and the reactions producing it and a detailed study of the processes of the photoproduction and photodecay of He^3 are the two topics currently under study. The experimental apparatus and the difficulties to be considered in the two studies are described. (J.S.R.)

11206 (LNF-63/47(p.124-33)) CATTURA RADIATIVA DEL MESONE μ^- IN ^{40}Ca E LA COSTANTE DELL'ACCOPPIAMENTO PSEUDOSCALARE INDOTTO. (Radiative Character of the μ^- Meson in Ca^{40} and the Induced Pseudoscalar Coupling Constant). M. Conversi, R. L. Diebold, and L. di Lella (European Organization for Nuclear Research, Geneva).

A study giving an indirect determination of the value and sign of the induced pseudoscalar coupling constant g_p is described. An experimental determination of the branching ratio R of the reaction $\mu^- + Ca^{40} \rightarrow K^{40} + \nu + \gamma$ was made with respect to the ordinary character of the μ^- meson in Ca^{40}. The experimental configuration is shown and discussed. The results are tabulated and compared graphically with theoretical predictions. A value of $g_p = (+9.4^{+5.5}_{-3.0})g_A$ was obtained. (J.S.R.)

11207 (LNF-63/47(p.182-8)) SPETTRI DI FOTONUCLEONI CON FOTONI MONOENERGETICI E DA BREMSSTRAHLUNG. (Photonucleon Spectra with Monoenergetic Photons and from Bremsstrahlung). C. Milone (Catania, Italy. Università. Istituto di Fisica).

The use of monoenergetic photons (15 to 30 Mev) for the study of the photoneutron spectra of medium light nuclei is illustrated by briefly reporting the results obtained on P, S, Al, and O^{16}. The experimental apparatus is described. The results in the case of S and O^{16} are compared with the results of previous studies to show how the use of monoenergetic photons gives more detailed information than other methods. (J.S.R.)

11208 (LNF-63/47(p.188-94)) POSSIBILITA' DI IMPIEGO DI GAMMA MONOCROMATICI IN ESPERIENZE DI ASSORBIMENTO E DIFFUSIONE RISONANTE. (Possibility for the Use of Monochromatic Gamma Radiation in Absorption and Resonant Diffusion Experiments). M. Giannini, P. Nunberg, D. Prosperi, and S. Sciuti (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Studi Nucleari, Casccia).

Possible applications of the annihilation of monochromatic positrons are reported. All experimental conditions considered are those obtainable with the first section of the Frascati linac. The characteristics of the monochromatic γ beam are defined, and the processes occurring during the absorption of a photon by a nucleus are reviewed. Diffusion of monochromatic γ radiation on isolated nuclear levels and on levels having a separation below experimental resolution is calculated. The calculations indicate the utility of this technique in the study of nuclear structure. (J.S.R.)

11209 (LNF-63/47(p.194-8)) SULLA FOTODISINTEGRAZIONE DEGLI ELEMENTI LEGGERI FRA 0 E 80 Mev. (Photodisintegration of Light Elements Between 0 and 80 Mev). S. Costa, F. Ferrero, S. Ferroni, B. Minetti, C. Molino (Italy. Istituto Nazionale di Fisica Nucleare, Turin); and R. Malvano (Italy. Istituto Nazionale di Fisica Nucleare, Genoa).

The photoneutron cross section of 14 elements from Li^6 to Co^{59} was measured from the threshold up to 80 Mev at the Turin electron synchrotron. The results obtained on the differential and integral cross sections for B, Li, O, C, Na, Al, Si, Mg, K, S, Ca, and P are graphed and briefly discussed. (J.S.R.)

11210 (LNF-63/47(p.199-204)) ESPERIMENTI DI FISICA NUCLEARE CON ELETTRONI (E POSITRONI). (Nuclear Physics Experiments with Electrons (or Positrons)). A. Agodi (Catania, Italy. Università. Istituto di Fisica).

The data that can be obtained from inelastic electron (or positron) scattering pertinent to the theory of nuclear structure are briefly indicated. The theory of inelastic scattering is reviewed, and the principal causes of uncertainty in the comparison of theory and experiment are shown in order to indicate the quality of information obtainable from the function $S(k,\omega)$ and from electron-nucleus inelastic scattering. The typical curve $d^2\sigma/d\Omega_e dk_e$ for constant k as a function of the energy transfer ω is described to give a panoramic summary. (J.S.R.)

11211 (LNF-63/47(p.205-13)) ELECTRON SCATTERING AT 180°. W. C. Barber (Stanford Univ., Calif. High-Energy Physics Lab.).

Electron scattering at the specific angle of 180°, in the study of nuclear reactions, has the advantages that the Mott cross section from the nuclear charge distribution is almost zero and the momentum transferred to the nuclear system is in the direction of the initial electron. The scope and results of such studies with the Stanford Mark II linear accelerator are briefly indicated. (J.S.R.)

11212 (LNF-63/47(p.247-9)) SOME PROBLEMS IN NUCLEAR STRUCTURE. A. De-Shalit (Weizmann Inst. of Science, Rehovoth, Israel).

Four basic problems in the field of nuclear physics still unresolved are briefly described. The problems are the intrinsic properties of the nucleon when it is immersed in nuclear matter, exchange currents in the nucleus, nuclear correlations, and the nature of nuclear excitations. (J.S.R.)

11213 (LNF-63/47(p.249-50)) MODELLO PERIFERICO E STRUTTURA DEI NUCLEI LEGGERI. (The Peripheral Model and the Structure of Light Nuclei). V. Wataghin (Turin. Università. Istituto di Fisica and Italy. Istituto Nazionale di Fisica Nucleare, Turin).

The applicability of the peripheral model to the study of the structure of light nuclei is briefly indicated. The specific problems in which this model was used are the reaction $n + d \rightarrow n + n + p$ with 14-Mev incident neutrons, the reaction $Li^6(\gamma,n)$ in the energy region $20 < E_\gamma < 30$ Mev, the (p,2p) reactions on Li^6 and Li^7 with 155-Mev incident protons, and inelastic scattering of electron on light nuclei. (J.S.R.)

11214 (LNF-63/47(p.250-4)) INTERAZIONI DI ELETTRONI CON IL DEUTERIO. (Interactions of Electrons with Deuterium). B. Bosco and P. Quarati (Turin. Università. Istituto di Fisica and Italy. Istituto Nazionale di Fisica Nucleare, Turin).

The various models proposed for the study of the interactions of electrons with deuterium are critically reviewed. (J.S.R.)

11215 (NP-13541) PRODUCTION OF HYPERFRAGMENTS FROM THE INTERACTIONS OF 500 Mev/c K^- MESONS WITH EMULSION NUCLEI. J. Lemonne, P. Renard, J. Sacton (Brussels. Universite); J. E. Allen, L. Bishara, D. H. Davis, and D. A. Garbutt (London. Univ. University Coll.). Dec. 1963. 9p.

The frequency of hyperfragment production in the interactions was estimated to be $10 \pm 1.0\%$, and the range dis-

tribution of the hyperfragments revealed an accumulation of hyperfragments of very short range. The distribution of the sum of the prong numbers of both the primary interaction and hyperfragment decay stars indicates a lower limit (underestimated) of 40% for the fraction of hyperfragments produced in heavy emulsion nuclei. The frequency of recoils and short prongs in the non-mesonic hyperfragment decay stars was also obtained as a function of hyperfragment range. It is concluded that nearly all the hyperfragments of range <10 μm (about 80% of the total number) are the residual spallation products resulting from meson (K^-) interactions with heavy nuclei. Those with ranges >10 μm exhibit the characteristics of light hyperfragments. (D.C.W.)

11216 (NP-13561) THE γ-ABSORPTION CROSS SECTION OF HOLMIUM IN THE DYNAMIC COLLECTIVE THEORY. Technical Report 310. Michael Danos (National Bureau of Standards, Washington, D. C.); and Walter Greiner (Maryland. Univ., College Park). Nov. 1963. 10p.

The cross section obtained by treating the complete collective nuclear model (described) is compared with experimental data for Ho^{165}. Within experimental precision, the collective model completely describes the photon absorption cross section for heavy nuclei, and there is some evidence for the excitation of vibrational giant resonance satellites. (D.C.W.)

11217 (SLAC-25(Pt.I)(p.200-5)) PAIR PRODUCTION OF VECTOR BOSONS IN THE COULOMB FIELD OF A NUCLEUS. J. Mathews (California Inst. of Tech., Pasadena).

The cross section for the photoproduction of vector boson pairs in iron (Z = 26, A = 56) was evaluated for photon energies of 3, 6, 10, and 20 Bev. (D.C.W.)

11218 (TID-20049) ACCURATE CALCULATIONS OF F FUNCTIONS FOR SUPERALLOWED BETA TRANSITIONS. Technical Report No. 10-26-55. Steven A. Moszkowski and Kathryn M. Jantzen (California. Univ., Los Angeles). [1955]. Contract AT(11-1)-34. 35p.

Accurate values of the f function correction to the half-life, t, of beta decay for most presently known superallowed beta transitions are obtained by numerical integration and by analytical calculations using previously published formulas. The results are presented both in tabular and in graphical form. Values of ft for most known superallowed transitions are listed. (auth)

11219 (TID-20105) AN EFFECTIVE INTERACTION FOR NUCLEAR HARTREE-FOCK CALCULATIONS. Frank Tabakin (Columbia Univ., New York). [1963]. Contracts AT(30-1)-2098 and AT(30-1)-1934. 81p.

An effective potential is presented which matches s, p, and d-wave N-N phase parameters up to 320 Mev without generating the usual strong, short-range correlations. A suitably defined set of separable potentials, including a non-central force and having small off-energy-shell matrix elements, is employed to produce smooth two-body wave functions. As a preliminary theoretical test of this effective interaction and of the applicability of perturbation theory, the average energy per particle, the single particle potential, and the symmetry energy of infinite nuclear matter were computed. A saturation of nuclear matter is found in first order at a fermi momentum of $k_F = 1.6\ f^{-1}$ with an average energy per particle of −8 Mev; second order contributions move the minimum to $k_F = 1.8\ f^{-1}$ with an average energy per particle of −14.1 Mev. This saturation is characterized by significant p-wave contributions. A convergence of perturbation theory is indicated by a ratio of second to first order potential energy of <0.10 in all but the coupled $^3S_1 + {}^3D_1$ state where the second order potential energy per particle is −4 Mev at $k_F = 1.8\ f^{-1}$. It is suggested that this smooth potential, which is related to the realistic interaction by a canonical transformation, can be used in nuclear Hartree-Fock calculations. (auth)

11220 (UCRL-11074) PURIFICATION METHODS USED FOR THE MASS-SPECTROMETRIC STUDY OF FISSION OF U^{235} AND U^{238} AT MODERATE ENERGIES (thesis). Roger C. Pettersen (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1963. Contract W-7405-eng-48. 24p.

The sources of natural rare-earth contamination in U_3O_8 pressed-powder targets for cyclotron bombardments were investigated further and studied more systematically. Mass-spectrometric analysis with an enriched Nd^{144} spiking solution is employed to follow the successive steps of target preparation, and to check the purity of the reagents and handling materials. Target purity is at the level of 2 parts per billion (ppb) for Nd^{144} when it is ready for cyclotron bombardment. A solvent-extraction method for Ce(IV) is modified to remove cerium-fission products quickly and quantitatively from a bombarded target. Yields for cerium and praseodymium isotopes were not determined owing to natural contamination in the extraction procedure. A previously known technique was used to determine independent fractional-chain yields for the mass-135 chain for fission of U^{238} and Th^{232} with 60-Mev helium ions. The independent fractional yields were found to fit a smooth Gaussian curve that was somewhat broader than that for lower-energy bombardments reported elsewhere. Relative independent yields for some of the cesium isotopes and relative cumulative yields for some cerium isotopes are also reported. (auth)

11221 ON THE SHAPE PARAMETERS AND THE MOMENTS OF INERTIA OF NON-AXIAL NUCLEI. Han-chou Liu (Nankai Univ., Tientsin, China). Acta Phys. Polon., 24: 568-81(Nov. 1963).

The second approximation of the shape parameter β for the Davydov and Filippov model is obtained by an improvement of the formula of Davydov and Filippov about the reduced transition probability B(E2, $^12 \rightarrow {}^10$). The second approximation of the shape parameters β and γ for the Mallman model is also obtained. The shape parameters of a large number of nuclei are calculated. A simple approximate method is given to obtain the individual nucleon wave functions in the non-axial Nilsson potential. By means of these wave functions, the moments of inertia along the principal axes of the Davydov and Filippov model and the Mallman model for the nuclei Er^{166} and Hf^{178} are calculated on the basis of the cranking model with pair-correlation interaction taken into account. The calculated results agree with observation at least in order of magnitude. (auth)

11222 COULOMB EXCITATION. P. H. Stelson and F. K. McGowan (Oak Ridge National Lab., Tenn.). Ann. Rev. Nucl. Sci., 13: 163-90(1963).

Processes, applications, and recent results involving Coulomb excitation are discussed. 97 references. (R.E.U.)

11223 NUCLEAR STRIPPING REACTIONS. Norman K. Glendenning (Univ. of California, Berkeley). Ann. Rev. Nucl. Sci., 13: 191-260(1963).

Single-nucleon stripping processes, single-nucleon transfer reactions other than (d,p), and two-nucleon transfer reactions are discussed. 190 references. (R.E.U.)

11224 MONITOR REACTIONS FOR HIGH ENERGY PROTON BEAMS. J. B. Cumming (Brookhaven National

Lab., Upton, N. Y.). Ann. Rev. Nucl. Sci., 13: 261-86 (1963). (BNL-7249)

Methods used to monitor internal and external proton beams are reviewed. Cross section data for C^{12} + p and Al^{27} + p are presented for E_p = 30 Mev to 30 Bev. Other proton-induced reactions are discussed. (R.E.U.)

11225 NUCLEAR MAGNETIC RESONANCE. S. Meiboom (Bell Telephone Labs., Inc., Murray Hill, N. J.). Ann. Rev. Phys. Chem., 14: 335-58(1963).

A review is presented on high resolution nuclear magnetic resonance and nuclear magnetic resonance in gases and solids. Interpretation of spectra, theory of shielding and spin-spin coupling constants, studies of chemical kinetics, and polymer solutions are discussed. 332 references are included. (P.C.H.)

11226 INELASTIC SCATTERING OF 14-Mev NEUTRONS ON LIGHT NUCLEI. E. M. Oparin, A. I. Saukov, and R. S. Shuvalov. At. Energ. (USSR), 15: 411-13(Nov. 1963). (In Russian)

The lack of data on spectra of inelastically scattered fast neutrons on light nuclei in the atomic number range from 6 to 16 complicates the calculation of the passage of neutrons through thick layers; experiments were therefore carried out on the spectra of 14-Mev neutrons after scattering by Li, Be, B, C, N, and O; the time-of-flight method was used for the experiments, employing a polymeric scintillation counter connected to a photomultiplier as the neutron detector. The instrument had a time resolution of 3.5×10^{-9} sec. The actual specimens included LiH, Be, graphite, melamin, and H_2O. Use of a shield allowed a ratio of 3 to 4 to be reached between the effect and the background in the elastic scattering range at count rates of 20 to 25 pulses/sec. The (n,2n) process complicated the evaluation of the scattering on Be and required a separate determination of the elastic and inelastic scattering, assuming that the elastically scattered neutrons from the (n,2n) reaction possess a spheric symmetry. The results are tabulated and also presented in graphic form. (TTT)

11227 A NEW LOOK AT NUCLEAR REACTIONS. Yasha Yavitch. Atomics, 17: 53-4(Jan.-Feb. 1964).

The concept of nuclear composition build-up from protons and neutrons and subsequently more complex structures such as deuterons and tritons is discussed in its effect on the interpretations of nuclear reactions from the physicists' point-of-view. (R.E.U.)

11228 LIFETIME MEASUREMENTS ON Cs^{133}. W. Flauger and H. Schneider (Justus Liebig-Universität, Giessen, Ger.). Atomkernenergie, 8: 453-7(Dec. 1963). (In German)

The lifetimes of Cs^{133} excited levels were either measured or estimated according to the method of delayed coincidences. The following values resulted: for 82-kev level, $T_{½} = (6.30 \pm 0.15) \times 10^{-9}$ sec; for 162-kev level, $T_{½} = (8.5 \pm 1.6) \times 10^{-11}$ sec; for 383-kev level, $T_{½} \leqq 9 \times 10^{-10}$ sec or $T_{½} \geqq 10^{-7}$ sec; and for 438-kev level, $T_{½} \leqq 9 \times 10^{-10}$ sec. (auth)

11229 ON THE INTERNAL MOTION OR THE INTERNAL DEGREES OF FREEDOM IN THE THEORY OF MATTER. Nguyen Hoang Phuong (Univ. of Hanoi, Tonkin, Indochina). Cahiers Phys., 17: 121-30(Mar. 1963). (In French)

The space of internal motion is identified as isotopic space, and the mass spectrum, interpreted as the result of internal motion, is obtained. The influence of non-linearities on the mass spectrum is also determined. (D.C.W.)

11230 McGILL DISCOVERS NEW TYPE OF RADIOACTIVITY. R. Barton, R. McPherson, and R. E. Bell (McGill Univ., Montreal). [Can. Nucl. Technol., 2: No. 4, 40-1 (1963).]

Delayed proton emission between 2 and 5 Mev is reported for proton cyclotron irradiation at 97 Mev of Si, Al, Mg, Na, F, N, and O. The mechanisms of the process and the experimental apparatus are discussed. (R.E.U.)

11231 FEATURES OF THE MÖSSBAUER EFFECT ON Sn^{119} IN ORGANIC TIN OXIDES. A. Yu. Aleksandrov, K. P. Mitrofanov, O. Yu. Oklobystin, L. S. Polak, and V. S. Shipnel (Inst. of Petrochemicals, Academy of Science, USSR and Moscow State Univ.). Dokl. Akad. Nauk SSSR, 153: 370-3(Nov. 11, 1963). (In Russian)

The isomeric shift δ, the quadrupole splitting parameter Δ, and the fraction of Mössbauer absorptions f' on Sn^{119} in compounds of the form $(C_nH_{2n+1})_2SnO$ were measured with the use of the 28.3-kev gamma from Sn^{119m}. The source was SnO at room temperature; the absorbers were at liquid nitrogen temperature, and each absorber had a Sn^{119} density of 33.5 mg/cm^2. The experiment was carried out with a constant-velocity device; the transmitted gammas were counted on a single-channel analyzer. For n = 1, 2, 4, 6, and 8, the values of f' are 0.06, 0.22, 0.17, 0.14, and 0.10 respectively (±10%). For all samples $\delta = 1.00 \pm 0.05$ mm/sec and $\Delta = 2.00 \pm 0.10$ mm/sec. From the results it is concluded that the alkyl tin oxides form macromolecules of the type -O-(SnR_2)-O- with covalent bonding to the tin atom. For the methyl group the macromolecule is cyclic, but it is linear for the larger groups. (TTT)

11232 STUDY OF NEUTRON-GENERATING NUCLEAR REACTIONS ON LIGHT NUCLEI. Ede Koltay (Nuclear Research Inst., Hungarian Academy of Sciences, Debrecen). Fiz. Szemle, 13: 42-51(Feb. 1963). (In Hungarian)

The nuclear reactions, studied in the light nuclei range, carried out in Hungary, are reviewed. Two accelerators with a maximum energy of 800 kev were used. Therefore the studies were limited to reactions that had a positive energy balance in this range, i.e., to elements with order numbers up to 15 to 20. The reaction mechanism of the photoelectric effect was examined by determining the energy and the directional distribution of the emitted nucleon on the basis of cross section measurements. In this connection János Erö and Lajos Keszthelyi investigated the $I^{127}(\gamma,n)I^{126}$ reaction, using γ radiation obtained by a cascade generator on the basis of the Li(p,γ)Be reaction. By examining the polarization of the residual nucleus following the polarization of the emitted nucleon, József Zimányi demonstrated that if the residual nucleus is excited, the emitted γ quantum will exhibit circular polarization. Both the Nuclear Research Institute at Debrecen and the Central Physical Research Institute developed methods for measuring the energy spectrum of the emitted particles. The 1.7-Mev Van de Graaff generator of the University of Debrecen was used for studying the energy-independent neutron detection in a neutron-generating nuclear reaction on the basis of the $Be^9(d,n)B^{10}$ reaction. Borbála Gyarmati investigated the polarization dependence of the cross section of the Compton scattering for measuring circular polarization of γ quanta. (TTT)

11233 SUPERCONDUCTING-TYPE PAIR INTERACTIONS IN THE NUCLEUS. Tivadar Siklós. Fiz. Szemle, 13: 67-71(Mar. 1963). (In Hungarian)

The superfluidity model of the nucleus, developed by V. G. Solov'ev (Doctoral dissertation, Dubna P-801, 1961) and coworkers, is useful in the study of the nuclei of rare earth and transuranium elements. With the help of the derived calculations it was found possible to explain the energy gap observed in even-even nuclei, the value of the pair energies and the moment of inertia of deformed nuclei, making use of the superfluidity type interactions; the ground and the slightly excited states of the nuclei are considered as superfluid states. The superfluidity model was also used to explain the structural changes of the nucleus in the case of α, β, and γ transitions in the range of $154 < A < 186$ and $A \geq 228$. The values obtained agree well with experimental data. Some of this work is still unpublished. (TTT)

11234 RADIOACTIVE DECAY OF SILVER^{110m}. A. Seshagiri Rao, V. Lakshminarayana, and Jnanananda Swami (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys., 2: 34-5(Jan. 1964).

A fast-slow type of Compton scintillation spectrometer was used for the study of the radioactive decay of the complex isotope, silver-110m. The coincidence Compton spectrum shows prominently most of the low intensity, low energy photon groups not appearing in the singles spectrum, thereby showing the suitability of a Compton scintillation spectrometer for such studies. (auth)

11235 ON THE ROLE OF NUCLEON STRUCTURE GROUPS IN PHOTONUCLEAR REACTIONS ON LIGHT NUCLEI. R. I. Dzhibuti (Tbilisi State Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 5, 124-6(1963). (In Russian)

Models of nuclear associations are used in studies of photonuclear reactions in light nuclei. Effects of structural nucleon group on the electromagnetic properties of nuclei in ground and excited states were analyzed. (tr-auth)

11236 NEW ISOTOPES OF EMANATION ^{222}Em AND ^{224}Em. F. D. S. Butement and V. J. Robinson (Univ. of Liverpool). J. Inorg. Nucl. Chem., 26: 1-7(Jan. 1964).

Two new isotopes of emanation were identified among the spallation products of thorium: their mass numbers and half lives were determined by milking the radium descendants, Ra^{223} and Ra^{224}. The values obtained were: Em^{223}, 43 ± 5 min, Em^{224}, 114 ± 6 min. Em^{223} was also made by the reaction $Em^{222}(n,\gamma)Em^{223}$, and the half life determined by the milking technique. The cross-sections for production of Em^{223} and Em^{224} in the 340 Mev proton bombardment of thorium were measured, and were used, together with other measured cross-sections, to construct a charge distribution curve for spallation products in this mass region. The curve is compared with those obtained at lower mass numbers. (auth)

11237 THE THERMAL NEUTRON CAPTURE CROSS-SECTION AND THE RESONANCE CAPTURE INTEGRAL OF ^{124}Xe. M. Bresesti, F. Cappellani, A. M. Del Turco, and E. Orvini (C.C.R. Euratom, Ispra, Italy). J. Inorg. Nucl. Chem., 26: 9-14(Jan. 1964).

The thermal neutron capture cross-section of Xe^{124}, its resonance capture integral (from 0.5 ev to ∞) and its effective capture cross-section in a reflector position of the Ispra 1 reactor were found to be 111 ± 11, 3600 ± 500, and 135 ± 13b, respectively. The values were determined by irradiating natural xenon and measuring the activity of I^{129}, the decay product of Xe^{129}. (auth)

11238 DOUBLE GAMMA EMISSION BY ATOMIC NUCLEI. S. R. de Groot (Instituut-Lorentz, Leiden). Ned. Tijdschr. Natuurk., 29: 219-20(June 1963). (In Dutch)

The probability of double gamma emission with respect to pair creation was theoretically determined, and it was compared with the experimental value obtained by studies on the de-excitation of O^{16} formed by the reaction $F^{19}(p,\alpha)O^{16}$. Very low-energy α emissions from high-energy states of O^{16} with 3^-, 2^3, and 1^- as spin and parity were found. These emitted exclusively singular γ radiation. The bremsstrahlung emission was correlated with the probability of gamma pair emission, and a probability of $2.5 \pm 1.1 \times 10^{-3}$ was found, in good agreement with the theoretical value. (J.S.R.)

11239 THE APPLICATION OF "ONE-GROUP" TRANSPORT THEORY TO β-RAY DOSIMETRY. K. O'Brien, S. Samson, R. Sanna, and J. E. McLaughlin (U. S. Atomic Energy Commission, New York). Nucl. Sci. Eng., 18: 90-6(Jan. 1964).

Calculations of the ionization density resulting from β fluxes produced by the decay of Pa^{234m} using constant-cross-section transport theory agree with experiment to better than 5%. The ionization densities were measured using an extrapolation chamber and a thin-walled ionization chamber. The experimental β absorption coefficients reported in 1931 by the International Radium-Standards Commission can be calculated to better than 15% using the same theory. (auth)

11240 ELASTIC SCATTERING OF FAST NEUTRONS FROM U^{235}. A. B. Smith (Argonne National Lab., Ill.). Nucl. Sci. Eng., 18: 126-9(Jan. 1964).

The differential cross section for the elastic scattering of neutrons from U^{235} was measured at ~50-kev intervals throughout the incident neutron energy range 0.3 to 1.5 Mev. Pulsed-beam time-of-flight techniques were employed to resolve the elastically scattered neutrons from those inelastically scattered and from the spectrum of fission neutrons. The experimental resolution extended from ~25 to ~65 kev at respective neutron energies of 0.3 and 1.5 Mev. All neutrons incurring an energy loss at the time of scattering, equal to or less than the respective resolution function, were considered elastically scattered. The experimental results were expressed in the form $[(d\sigma(el)/d\Omega) = \sigma(el)/4\pi] [1 + \sum_{i=1}^{5} W_i P_i]$ where $\sigma(el)$ is the total elastic cross section, P_i are Legendre polynomials, and W_i are experimentally determined coefficients. The elastic transport cross section was derived from the measurements. (auth)

11241 CLOSED-SHELL EFFECTS ON THE CLUSTER SINGULARITIES OF THE NUCLEON-NUCLEUS VERTEX PART. P. Stichel (Universität, Hamburg). Nuovo Cimento (10), 31: 250-4(Jan. 1, 1964).

Dispersion relations and Feynmann graphs are used to show results on the nucleon–nucleus vertex part for light nuclei. The nonrelativistic second-quantized Schroedinger theory is used for defining the vertex part nucleon–nucleus — residual nucleus. (R.E.U.)

11242 NUCLEAR QUADRUPOLE EFFECTS IN "HIGH MAGNETIC FIELDS" IN LIQUIDS. B. Bonera and A. Rigamonti (Università, Pavia, Italy). Nuovo Cimento (10), 31: 281-96(Jan. 16, 1964).

Nuclear relaxation in liquids via quadrupolar interaction was studied. The electric field gradients due to the charges external and internal to the molecule were calculated for several liquids. With the Fourier integral method the probabilities for transitions among unperturbed nuclear magnetic energy levels were related to the motions and then evaluated. Experimental results for the nuclear re-

laxation of deuterium in the D_2O molecule in different surroundings are reported and discussed. These results seem to confirm the validity of the mechanism proposed for the nuclear quadrupolar relaxation in liquids. (auth)

11243 MEASUREMENT OF HALF-LIVES OF THE 570 kev LEVEL OF ^{207}Pb AND 2083 kev AND 2412 kev LEVELS OF ^{140}Ce. Girish Chandra (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 31: 297-301(Jan. 16, 1964).

Delayed γ-γ and β-γ coincidence technique was employed to measure the half-lives of the 570-kev level of Pb^{207} and 2083 and 2412-kev levels of Ce^{140} nuclei, which are found to be 1.8×10^{-10}, $(3.3 \pm 0.4) \times 10^{-9}$, and $(7 \pm 3) \times 10^{-11}$ sec, respectively. A bridge type coincidence circuit was used as time-to-amplitude converter for these measurements. Its performance is described. (auth)

11244 ON THE QUESTION OF Y_0^*-PRODUCTION IN K^--CAPTURES ON EMULSION NUCLEI. B. Bhowmik, P. C. Jain, P. C. Mathur, and N. T. Venkata Lakshmi (Univ. of Delhi). Nuovo Cimento (10), 31: 465-9(Jan. 16, 1964).

Nuclear emulsions were exposed to a meson(K^-) beam at 44 Mev/c to investigate the production of the $\Sigma\pi$ resonant state Y_0^*. Momentum and mass distributions indicate that K^--capture takes place in C^{12}, N^{14}, and O^{16}. It is shown that the observed peak in the $\Sigma\pi$ total momentum distribution results from the selective K^--capture process rather than from the Y_0^* production. (C.E.S.)

11245 OPTICAL MODEL PLUS RESONANCE ANALYSIS OF THE ELASTIC SCATTERING OF PROTONS BY C^{12}. T. Tamura and T. Terasawa (Oak Ridge National Lab., Tenn.). Phys. Letters, 8: 41-3(Jan. 1, 1964).

Data for energies between 20 and 24.5 Mev were analyzed by assuming that the parameters were energy independent and that the scattered amplitude could be described by a sum of optical model and Breit-Wigner terms. Almost complete agreement with the data was obtained, and the calculation of the angular distribution showed that the optical and resonance parameters used were reasonable. (D.C.W.)

11246 APPROXIMATE SIMPLICITIES OF INTERMEDIATE-COUPLING WAVE FUNCTIONS. A. B. Clegg (Oxford Univ.). Phys. Letters, 8: 43-4(Jan. 1, 1964).

An O^{16} simplicity in which the lowest intermediate coupling state (J = 3− and E = 6.14 Mev) is a collective excitation of the ground state (1 p-shell) and has single-particle properties is discussed. The wave function overlaps strongly with both the lowest LS-coupling state and the lowest jj-coupling state. (D.C.W.)

11247 p-WAVE RESONANCES OF Th^{232}. L. M. Bollinger and G. E. Thomas (Argonne National Lab., Ill.). Phys. Letters, 8: 45-7(Jan. 1, 1964).

Small transmission dips were observed in neutron time-of-flight spectra for Th^{232}. On the basis of comparisons of the widths of these resonances with expected widths for p- and s-wave resonances and consideration of the probability of s-wave excitation of the small resonances, the resonances were identified almost entirely as p-wave resonances. The p-wave strength function and the upper limit of the total radiation width for p-wave resonances were estimated to be 0.5×10^{-4} and 0.060 ev, respectively. (D.C.W.)

11248 DIRECT ELECTRODISINTEGRATION OF Li^7 INTO TRITON PLUS ALPHA-PARTICLE. G. R. Bishop and M. Bernheim (Ecole Normale Supérieure, Orsay, France). Phys. Letters, 8: 48-51(Jan. 1, 1964).

Data on the electron inelastic scattering cross section of Li^7 before the 4.63-Mev level is attained is discussed in terms of Li^7 disintegration into a triton and an alpha particle. (D.C.W.)

11249 MEASUREMENT OF LIFETIMES OF NUCLEAR EXCITED STATES BY DOPPLER SHIFT ATTENUATION METHOD. M. A. Eswaran, H. E. Gove, A. E. Litherland, and C. Broude (Chalk River Nuclear Labs., Ont.). Phys. Letters, 8: 52-3(Jan. 1, 1964).

The lifetimes of 0.668, 0.961, and 1.327 Mev levels in Cu^{63}; 0.770, 1.114, and 1.482 Mev levels in Cu^{65}; and 1.172 and 0.845 Mev levels in Ni^{62} and Fe^{56}, respectively, were measured by the Doppler technique. The results are in excellent agreement with determinations by other methods. (D.C.W.)

11250 ELASTIC SCATTERING OF PROTONS AT 155 Mev ON Li^6 AND Li^7. B. Tatischeff, N. Marty, X. de Bouard, J. G. Fox, B. Geoffrion, and C. Rolland (Faculté des Sciences, Orsay, France). Phys. Letters, 8: 54-6 (Jan. 1, 1964). (In French)

The effective differential cross sections for proton elastic scattering by Li^6 and Li^7 were measured, together with the polarization of the scattered protons. The results are compared with other measurements and with impulse approximation calculations. Measurements of the polarization in the excitation of the 0.478-Mev, $\frac{1}{2}^-$ level confirms the hypothesis that the transition from the fundamental $\frac{3}{2}^-$ state to the excited $\frac{1}{2}^-$ state is made essentially without spin flip. (D.C.W.)

11251 INDICATIONS ON THE STRUCTURE OF O^{16} AFTER THE REACTION (p,d) AT 155 Mev. D. Bachelier, M. Bernas, I. Brissaud, C. Detraz, N. K. Ganguly, and P. Radvanyi (Faculté des Sciences, Orsay, France). Phys. Letters, 8: 56-7(Jan. 1, 1964). (In French)

The energy spectrum of deuterons from the reaction $O^{16}(p,d)O^{15}$ at 155 Mev was measured. Intense peaks at 0 and 6.0 Mev, corresponding to the fundamental ($\frac{1}{2}^-$) and 6.16-Mev ($\frac{3}{2}^-$) levels of O^{15}, were observed. These peaks correspond also to neutron pickup in the $p^1/_2$ and $p^3/_2$ subshells. A less intense peak was observed at 9.8 Mev, corresponding probably to configuration mixing in either the O^{16} fundamental state or the O^{15} final state. The intensities of the deuteron groups agree well with shell model calculations. (D.C.W.)

11252 THE DECAY OF 155-d Lu^{177}. L. Kristensen, M. Joergensen, O. B. Nielsen, and G. Sidenius (Universitet, Copenhagen). Phys. Letters, 8: 57-60(Jan. 1, 1964).

The decay scheme of the 970-kev ($\frac{23}{2}^-$) state of Lu^{177}, with a half life of about 155 days, was obtained. The high-spin isomer de-excites through rotational bands built on three single-particle levels. An analysis of the rotational bands was performed and was checked by calculating branching ratios for transitions. (D.C.W.)

11253 THREE-PARTICLE EXCITATIONS IN Lu^{177} AT 1230 AND 1240 kev. H. S. Johansen, M. Joergensen, O. B. Nielsen, and G. Sidenius (Universitet, Copenhagen). Phys. Letters, 8: 61-4(Jan. 1, 1964).

The decay scheme of Yb^{177} was obtained by studying beta, gamma, and electron-gamma coincidence spectra. The intensities and log ft values of the low-energy beta groups to the 1231 and 1241-kev three-particle levels were determined. An assignment of $^{11}/_2^+$ is suggested for the 1231-kev level. The 1240-kev level may be one of the $\frac{7}{2}^+$ states of the same three-particle configuration. (D.C.W.)

11254 EVIDENCE FOR ROTATIONAL STATES UP TO 14^+ IN Dy^{160}. K. Kotajima and D. Vinciguerra (Insti-

tuut voor Kernphysisch Onderzoek, Amsterdam). Phys. Letters, 8: 68-70(Jan. 1, 1964).

Rotational states with angular momenta >10 ħ were sought to check predictions about the upper limit of the ground state rotational band (at J ≈ 12 for A ≈ 180 and at J = 18 for A ≈ 238). The gamma and conversion electron-gamma spectra following the $Gd^{160}(\alpha,4n)Dy^{160}$ reaction were used. Evidence for the existence of rotational states up to 14^+ was obtained. (D.C.W.)

11255 NUCLEAR CROSS SECTION FLUCTUATIONS. P. A. Moldauer (Argonne National Lab., Ill.). Phys. Letters, 8: 70-2(Jan. 1, 1964).

The dependence of mean square fluctuations in nuclear reaction cross sections on Γ/D is examined. D is the average spacing of resonance energies, and Γ is the total width. (D.C.W.)

11256 NEUTRINO PRODUCTION OF LEPTON PAIRS. W. Czyz (Inst. for Theoretical Physics, Copenhagen) and J. D. Walecka. Phys. Letters, 8: 77-9(Jan. 1, 1964).

The high-energy asymptotic value of the total cross section for the production of lepton pairs in neutrino reactions was calculated. Applicability of the calculations to experiments is discussed. The incoherent contribution to the asymptotic cross sections for the reactions coming from protons and neutrons was also calculated. (D.C.W.)

11257 THE ENERGY AND ISOTOPIC SPIN DEPENDENCE OF THE NUCLEAR OPTICAL MODEL POTENTIAL. J. Dabrowski (Univ. of California, La Jolla). Phys. Letters, 8: 90-2(Jan. 1, 1964).

The isotopic spin-dependent part of the single-particle nuclear potential is calculated and compared with empirically determined parameters of the optical model in the center of heavy nuclei. The depth of the nuclear optical potential for neutrons and protons was also calculated. (D.C.W.)

11258 THEORY OF ELECTRON CAPTURE IN H^+-H COLLISIONS. Benjamin Roth (City Univ. of New York, Brooklyn). Phys. Rev., 133: A1257-62(Mar. 2, 1964).

The theory of electron capture in H^+−H collisions at kilovolt energies is developed. A strong coupling is assumed between the electron ground states in the target and scattered atoms. The method depends on an approximation that amounts to neglecting terms of order K^{-1} compared to 1, where K is the wave number in atomic units for the collision of the two protons. Calculations are made for lab energies from 0.6 to 50 kev, and the results compare favorably with the experimental results of Lockwood and Everhart. The center-of-mass correction accounts for the damping of resonances and otherwise produces a considerable effect. The method is applied to developing a formula for the relative probability for capture into an excited state. It is estimated that this probability is small. (auth)

11259 CLASSICAL IMPULSE APPROXIMATION FOR INELASTIC ELECTRON-ATOM COLLISIONS. Robert C. Stabler (RCA Labs., Princeton, N. J.). Phys. Rev., 133: A1268-73(Mar. 2, 1964).

Analytic expressions for the ionization and excitation cross sections of atoms by electrons are derived using the classical impulse approximation, i.e., by considering only the Coulomb interaction between the incident electron and one bound electron. The results obtained are slightly simpler and more self-consistent than those obtained in an earlier calculation by Gryzinski. The cross sections are found to be roughly as good as those obtained by the Born approximation except in the high-energy limit. The apparent superiority of Gryzinski's theory to quantum approximations arises from a subsidiary approximation made in averaging the cross section over the initial distribution rather than from the kinematic description of the bound electrons or the nature of the impulse approximation itself. The Coulomb cross section for transfer of energy ΔE between two particles of equal mass m, charge e, initial kinetic energies E_1 and E_2, relative velocity V, with an isotropic initial angular distribution is bound to be $Vd\sigma/d(\Delta E) = 2^{1/2}\pi e^4|\Delta E|^{-2}(mE_1E_2)^{-1/2}(\varepsilon^{1/2} + \frac{1}{3}\varepsilon^{3/2}/|\Delta E|)$, where ε is the smallest of the four initial and final kinetic energies. For single ionization this cross section is found to increase as the 3/2 power of the excess energy above threshold, reach a maximum at about $2\frac{1}{2}$ times the threshold energy, and decrease as E^{-1} at high energies. For hydrogenic atoms in any state the cross section goes to 5/3 the classical Thomson ionization cross section in the high-energy limit. (auth)

11260 ELECTRON EMISSION FROM MESONIC ATOMS. G. T. Condo, R. D. Hill, and A. D. Martin (Univ. of Illinois, Urbana). Phys. Rev., 133: A1280-94(Mar. 2, 1964).

The yield and energy distribution of electrons emitted from absorptions of stopping K^- mesons in nuclear emulsions were measured. In the electron energy range from 20−70 kev, the yield in the heavy elements Ag and Br was analyzed to consist of 14% background electrons contributed by radioactivity, and 24% contributed by the radiationless Auger process in the K-mesonic atom. This Auger yield is considerably less than would be expected theoretically from existing conventional analyses of the K^--mesonic atom cascade in Ag and Br. A possible explanation of the discrepancy is given in terms of a description involving Stark mixing in highly excited mesonic states. This gives rise to nuclear capture from the f and d angular momentum substates of highly excited levels. The probable effect of such a capture mechanism on the rate of multinucleon captures in nuclei is briefly discussed. Further experimental results are given on electron emission from π-mesonic atoms, and other data on μ-mesonic and Σ-hyperonic atoms are also reviewed. (auth)

11261 POLARIZATION EFFECTS IN SLOW NEUTRON SCATTERING. II. SPIN-ORBIT SCATTERING AND INTERFERENCE. M. Blume (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 133: A1366-9(Mar. 2, 1964). (BNL-7474)

The theory of polarized neutron scattering is extended to include spin-orbit scattering in magnetic substances. The cross section for scattering of a polarized beam includes, in addition to the Schwinger interference term between nuclear and spin-orbit scattering, a polarization-dependent interference term between spin-orbit and magnetic scattering. The latter depends on the real part of the product of magnetic and spin-orbit structure factors, whereas the Schwinger term depends on the imaginary part of the product of the nuclear and spin-orbit structure factors. A calculation shows that this effect should easily be observable in an isotopic mixture of Ni that has no coherent nuclear scattering. (auth)

11262 ENERGY GAP IN FINITE NUCLEI CALCULATED IN THE SLAB MODEL. R. C. Kennedy, L. Wilets, and E. M. Henley (Univ. of Washington, Seattle). Phys. Rev. Letters, 12: 36-9(Jan. 6, 1964).

Calculations for the energy gap of a finite system with internucleonic potentials that reproduce singlet, s-wave scattering data are performed. A slab model, used to simulate a finite nucleus, is of infinite extent in two directions but is confined to a thickness in the third. The energy gap is found from the BCS integral equation. (R.E.U.)

11263 ALPHA PARTICLES FROM THE PROTON BOMBARDMENT OF LIGHT NUCLEI. J. Kuperus, P. W. M. Glaudemans, and P. M. Endt (Rijksuniversiteit, Utrecht). Physica, 29: 1281-95(Dec. 1963).

Resonances in the α-particle yield from proton bombardment of Na^{23}, Al^{27}, P^{31}, and $Cl^{35,37}$ were investigated in the energy range E_p = 200 to 850 kev. Resonance energies, strengths, and the ensuing partial widths are reported. Angular distribution measurements yield spin and parity, formation mixing parameters, and/or magnetic substate population probabilities of several resonance levels. (auth)

11264 STUDY OF ^{182}Ta DECAY SCHEME BY COINCIDENCE METHOD. M. S. El-Nesr and E. Bashandy (Atomic Energy Establishment, Cairo). Physica, 29: 1441-8(Dec. 1963).

The decay scheme of the 115-day electron emitter Ta^{182} was studied using an electron-gamma and a gamma-gamma coincidence spectrometer together with a 400-channel pulse-height analyzer. From the coincidence studies, the energy levels at 100, 329, 1222, 1255, 1289, 1331, 1375, 1487, and 1554 kev are established. (auth)

11265 GAMMA SPECTRA OF NATURAL ELEMENTS ACTIVATED IN A NUCLEAR REACTOR. Minoru Okada (Government Chemical Industrial Research Inst., Tokyo). Radioisotopes (Tokyo), 12: 234-52(May 1963). (In Japanese)

Gamma spectra of natural elements activated in a nuclear reactor were measured and compiled. The compilation covers most natural elements that can be activated to gamma-active nuclides. Target materials, radionuclides formed, irradiation time, and cooling time are given for each spectra chart. The activations were performed in a reactor at neutron fluxes ranging from 10^{10} to 10^{12}/cm^2 sec, and cadmium ratio of the neutron was about three. A well-type sodium iodide scintillation crystal mounted on a Du-Mont 6292 photomultiplier was used as a gamma detector. This detector was connected first to a single-channel and later to a 256-channel pulse-height analyzer for the specta analyses. (Nucl. Sci. Abstr. Japan, Vol. 2, No. 4.)

11266 H^3 BOUND STATE AND INTERACTION APPROXIMATING OVER THE ENERGY RANGE IN THE VICINITY ABOVE AND BELOW THE THRESHOLD OF NUCLEAR REACTIONS. Yoshinori Shimooke (Japan Atomic Energy Research Inst., Tokyo). Soryushiron Kenkyu, 27: 178-93(May 1963). (In Japanese)

On the bases of the author's preceding investigation on two-nucleon scattering in the low energy range, i.e., the validity of models of intermediate state approximated by the deuteron state (np scattering, J = 1) and virtual level (np scattering, J = 0) respectively for description of the phenomenon and the possibility of taking a bond constant and cut-off value common to these two processes and bringing these models into unity, a generalization of the above-mentioned nucleon interaction is introduced. Under the hypothesis of isosopin independence of interaction, coupling of the above-mentioned np, J = 0 state with virtual level is extended to coupling of two-nucleon J = 1, J = 0 state with virtual level in general, and the two-nucleon interaction symmetric in T and J is given, depending on analytical considerations of S matrix. It is postulated that this interaction applies to a range below the threshold as wide (~20 Mev kinetic energy in gravity center system) as that above. This applicable range is wide enough center system) as that above. This applicable range is wide enough to cover all nuclei, which are bound states of nucleons, because of saturation of interaction between nucleons. Therefore, a two-nucleon interaction having many applicable objects of nucleons inside the nucleus is effectively considered to be an elementary process in this range. First of all on the hypothesis of this interaction, the three-body bound state was examined. Taking values of parameters $g_{tc}2/4\pi = 0.308$, $g_{sc}2/4\pi = 0.0305$, $\Lambda = 122$ Mev, and $\lambda = 235$ Mev, the calculated value of the H^3 bound energy is $BH^3 = 11.0$ Mev. The interaction model results in fairly good agreement with potential theory neglecting tensor force. Taking tensor force into the interaction model and searching out the necessity or reality of this model will be the problems in the future. (Nucl. Sci. Abstr. Japan, Vol. 2, No. 4)

11267 ON INELASTIC DIFFRACTION SCATTERING WITH EXCITATION OF TWO-PHONON STATES OF NUCLEI. Y. A. Berezhnoi (Khar'kov Inst. of Physics). Ukr. Fiz. Zh., 8: 929-34(Sept. 1963). (In Ukrainian)

Inelastic diffraction scattering of fast particles with excitation of two-phonon states of nuclei is considered. It is shown that the phase rule, which is true for the differential scattering cross sections with excitation of the one-phonon levels of nuclei, does not hold for scattering cross sections with excitation of two-phonon levels. A comparison of the theory with the experimental data on the scattering of alpha particles of 43 Mev energy with excitation of the two-phonon level of the Ni^{60} nucleus (Q = –2.50 Mev) indicates good agreement of theory and experiment. (auth)

11268 MEASUREMENT OF GYROMAGNETIC RATIOS OF NUCLEI IN THE EXCITED STATE. A. K. Walter, I. I. Zalyubovskii, V. A. Klyucharev, and V. D. Afanasev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR and Khar'kov State Univ.). Ukr. Fiz. Zh., 8: 935-46(Sept. 1963). (In Ukrainian)

An experimental set-up for measuring gyromagnetic ratios of the excited state of nuclei by the method of angular γ-γ correlation is described. The experiment was conducted on the determination of the gyromagnetic ratios in the measurement of the angular correlation function of a definite cascade in a magnetic field and without it. The value of the gyromagnetic ratio g is determined from the measured value of azimuthal bias of the correlation function. Because of the interaction of the nuclei with electric and magnetic fields of the radioactive source the processing of data is involved. The results of the measurements are given for the gyromagnetic ratios of the second excited state of Ta^{181}, g = 1.294 ± 0.055, first excited state of W^{182}, g = 0.285 ± 0.042. (auth)

11269 IDENTIFICATION AND DETERMINATION OF THE PARAMETERS OF RESONANCE LEVELS OF ERBIUM. M. F. Vlasov and A. L. Kirilyuk (Kiev Inst. of Physics). Ukr. Fiz. Zh., 8: 947-53(Sept. 1963). (In Ukrainian)

A set-up is described for the measurement of total neutron cross sections of separated isotopes by the time-of-flight method. Its characteristics are presented: the form and duration of the neutron flash and the dependence of the background through the rotor of the chopper on the energy. The resonance levels of erbium isotopes are identified. (auth)

11270 POLARIZATION IN PROTON SCATTERING ON ALUMINUM AT 6.6 Mev. F. Asfur, I. Grancha, E. A. Romanovskii, G. M. Timushev, and M. M. Khasani. Vestn. Mosk. Univ., Ser. III, Fiz., Astron., No. 5, 8-10(Sept.-Oct. 1963). (In Russian)

A special magnetic analyzer was used for measuring

polarization in 6.6-Mev proton scattering on aluminum at 60°. Polarization for elastic scattering on Al^{27} was +15.9 ±3%. (R.V.J.)

11271 E0-CONVERSION ON HIGHER NUCLEAR SHELLS. L. A. Borisoglebskii. Vestn. Mosk. Univ., Ser. III, Fiz., Astron., No. 5, 74-9(Sept.-Oct. 1963). (In Russian)

A point nucleus approximation, without screening, was used in developing general formulas for absolute and relative E0-conversion probabilities and for correction factors for arbitrary nuclear shell models. Screening was evaluated by a semi-empirical method using experimental values for conversion electron bond energy and Slater parameters. Approximate numerical values of relative E0-conversion probabilities were correlated with more accurate experimental data. (tr-auth)

11272 CROSS SECTION FOR ABSORPTION OF γ-QUANTA BY CARBON NUCLEI IN THE GIANT RESONANCE REGION. N. A. Burgov, G. V. Danilyan, B. S. Dolbilkin, L. E. Lazareva, and F. A. Nikolaev (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR and Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 45: 1693-1703(Dec. 1963). (In Russian)

The nuclear absorption cross section of γ rays was measured in the interval of 13–27 Mev by the absorption method for carbon. A pair magnetic spectrometer was used as a γ-quantum detector. The measurements were carried out with a 250-Mev synchrotron. The cross-section curve has five maxima at the energy of 16.5, 17.6, 19.1, 23, and 25.6 Mev. The integral cross section in the given energy interval is equal to 84 ± 10 Mev · mbarns. The measured cross section of the C^{12} nuclear absorption in the region of giant resonance is compared with the results of theoretical calculations and the experimental data on spectra of photonucleons and on the cross section of $C^{12}(\gamma,n)$ and $C^{12}(\gamma,p)$ reactions in this energy region. (auth)

11273 COLLECTIVE EFFECTS IN THE Cs^{131} NUCLEUS. G. A. Vartapetyan, A. G. Khudaverdyan, and T. A. Garibyan. Zh. Eksperim. i Teor. Fiz., 45: 1720-6(Dec. 1963). (In Russian)

New data relating to the Cs^{131} nucleus are presented. Some of them are not consistent with the attempts to explain all Cs^{131} levels by invoking a single rotational band of an asymmetric nucleus. A new transition at 907-kev is detected. The half life of the 1039-kev level is $T_{\frac{1}{2}} < 2 \times 10^{-9}$ sec and the ratio of the intensities of the 918 and 907-kev transitions is found to be $I_{\gamma_{918}}/I_{\gamma_{907}} = 14.5 \pm 3$. The half life of the 133-kev level, $T_{\frac{1}{2}} = (13.5 \pm 0.5) \times 10^{-9}$ sec is confirmed. However, the values of B(E2) for the 124 and 133-kev transitions and also the ratio $B(E2)_{exp}/B(E2)_{single} > 1$ for the 495-kev transition indicate that collective effects take place in the Cs^{131} nucleus. A more adequate model should require the interaction of rotational, vibrational, and single-particle motions to be taken into account. Results of measurement of the half life of the 438-kev level of the Cs^{133} nucleus as well as the ratio $B(E2)_{exp}/B(E2_{single}$ for the 356-kev transition are presented. (auth)

11274 ELASTIC SCATTERING OF 3.4–4.2 Mev PROTONS ON Ni^{62} AND Ni^{64} ISOTOPES. V. Ya. Golovnya, A. P. Klyucharev, and B. A. Shilyaev. Zh. Eksperim. i Teor. Fiz., 45: 1727-30(Dec. 1963). (In Russian)

Angular distributions of 3.4, 3.65, 3.76, and 4.2-Mev protons elastically scattered on Ni^{62} and Ni^{64} nuclei are measured in the angular range between 30 and 90° (laboratory system). The nuclear interaction range between the incident proton and nucleus is determined on basis of the point of deviation of the angular distribution curves from the Rutherford law in the quasiclassical approximation. The ranges derived from the experimental data systematically exceed those calculated. (auth)

11275 PROTON CAPTURE REACTIONS ON ATOMIC NUCLEI. I. Berkesh, I. Dézhi, L. Kestkheli, and E. Fodor (Central Research Inst. of Physics, Hungarian Academy of Sciences, Budapest). Zh. Eksperim. i Teor. Fiz., 45: 1731-6(Dec. 1963). (In Russian)

The following nuclear reactions were investigated: $Na^{23}(p,\gamma)Mg^{24}$ for $E_p = 250$ kev $Mg^{26}(p,\gamma)Al^{27}$ for $E_p = 292$ kev, $Al^{27}(p,\alpha_0)Mg^{24}$ for $E_p = 224$ kev and $P^{31}(p,\alpha_0)Si^{28}$ for $E_p = 355$ kev. Conclusions concerning the levels and their decay schemes are drawn on basis of the γ spectra measured. It is deduced from the angular distribution that the spin and parity of the 11.933-Mev level in Mg^{24} is 2^+ or 3^+ and the spin and parity of the 8.554-Mev level in Al^{27} is $\frac{1}{2}$ or $\frac{3}{2}^+$. (auth)

11276 INVESTIGATION OF NEUTRON RESONANCES IN Rh^{103}. Nai-yen Wang, I. Vizi, V. N. Efimov, et al. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 1743-53(Dec. 1963). (In Russian)

Transmission, scattering, and capture for several Rh^{103} samples are carried out on a slow neutron spectrometer. The measurements were performed at resolutions of 0.04, 0.08 and 0.05 μ sec/m. The parameters of 17 resonances were determined. Spins of 8 levels were determined. A deviation from the Porter–Thomas law with a single degree of freedom was found. It can be explained by the fact that from 4 to 5 resonances are due to neutrons with orbital momenta l = 1. Force functions for neutrons with l = 0 and l = 1 were computed under these assumptions. (auth)

11277 ASYMMETRY OF DOUBLE SCATTERING OF NEUTRONS ON HELIUM. P. S. Otstavnov, G. N. Lovchikova, and V. I. Popov. Zh. Eksperim. i Teor. Fiz., 45: 1754-8(Dec. 1963). (In Russian)

Right-left asymmetry of doubly scattered initially unpolarized 15-Mev neutrons is measured by double scattering of neutrons on gaseous helium. Satisfactory agreement is obtained with calculations based on Seagrave phase shifts. (auth)

11278 LIFETIME OF THE 4^+(2310 kev) LEVEL IN Ti^{48}. A. F. Akkerman, V. L. Kochetkov, V. A. Chekanov, V. V. Suvorov, and A. K. Shtolts (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Zh. Eksperim. i Teor. Fiz., 45: 1778-83(Dec. 1963). (In Russian)

The lifetime of the 4^+ (2310 kev) level of Ti^{48} was determined by investigating the dependence of the resonance scattering cross section on the source density. The lifetime derived is 2×10^{-12} sec, which is about 2.5 times greater than the lifetime expected on basis of the vibrational model. The results are discussed in light of conclusions drawn on basis of a model in which pair correlation of nucleons is taken into account. (auth)

11279 SHORT RANGE PRODUCTS FROM NUCLEAR DISINTEGRATIONS INDUCED BY PROTONS WITH ENERGIES BETWEEN 2 AND 9 Gev. P. A. Gorichev, O. V. Lozhkin, and N. A. Perfilov. Zh. Eksperim. i Teor. Fiz., 45: 1784-92(Dec. 1963). (In Russian)

An analysis is presented of the disintegrations of heavy nuclei in emulsions in which two short range particles are emitted mainly in the opposite directions. It is shown that disintegrations of this type should not be ascribed to fission of Ag or Br nuclei but to disintegrations in which a short

range fragment and a recoil nucleus are formed. The upper limit of the cross section for fission of Ag and Br nuclei induced by 2 to 9-Bev protons is ~1 mb. (auth)

11280 FRAGMENT PRODUCTION ON EMULSION NUCLEI INDUCED BY 7.5 Bev π^- MESONS. Yu. F. Gagarin and N. S. Ivanova (Ioffe Inst. of Physics, Leningrad). Zh. Eksperim. i Teor. Fiz., 45: 1793-1802(Dec. 1963). (In Russian)

Characteristic features of production of fragments due to interaction between 7.5-Bev mesons(π^-) and heavy emulsion nuclei (Ag,Br) are investigated by the photographic emulsion method. Angular, energy, and charge distributions of the emitted fragments are measured. Disintegrations with and without fragment production are analyzed. On the basis of the analysis and comparison of the data with those on fragmentation induced by mesons(π) of various energy it is concluded that cascade nucleons play a significant role in the fragmentation process. Comparison of the main characteristics of the fragments with the corresponding data for hyperfragments lead to conclusions regarding the process of hyperfragment formation. (auth)

11281 MEASUREMENT OF THE TOTAL MUON CAPTURE RATE IN He^3. O. A. Zaimidoroga, M. M. Kulyukin, B. Pontekorvo, R. M. Sulyaev, I. V. Falomkin, A. I. Filippov, V. M. Tsupko-Sitnikov, and Yu. A. Shcherbakov (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 1803-7(Dec. 1963). (In Russian)

The total muon capture rate in He^3 is measured with a high pressure diffusion chamber. It is found to be $\lambda_{exp} = 2140 \pm 200\ sec^{-1}$. This result is in agreement with the calculations of Primakoff carried out on the basis of the theory of universal weak interaction. (auth)

11282 NEW DATA ON α-DECAY OF AMERICIUM ISOTOPES. S. A. Baranov, V. M. Kulakov, and V. M. Shatinskii. Zh. Eksperim. i Teor. Fiz., 45: 1811-18(Dec. 1963). (In Russian)

Results of investigation of radioactive decay of the isotopes Am^{243} and Am^{241} are presented. From an analysis of the α spectra of the indicated nuclei the existence of new fine structure α groups can be established, part of which belong to Am^{243}. A possible interpretation of newly discovered energy levels in the Np^{239} and Np^{237} nuclei is discussed. According to this interpretation some new rotational bands should exist that have the initial characteristics $^3/_2^-[521]$ and $^3/_2^+[651]$. Furthermore, some of the levels can be assigned to the octopole class in schemes of these odd-even nuclei. (auth)

11283 SCATTERING OF PROTONS WITH ENERGIES BELOW 5 Mev ON Ne^{20}. Kh. Khulubei, Zh. Frants, N. Martalogu, N. Scyntei, M. Ivashku, A. Berinde, and I. Nyamu (Inst. of Atomic Physics, Bucharest). Zh. Eksperim. i Teor. Fiz., 45: 1822-6(Dec. 1963). (In Russian)

The excitation functions for elastic and inelastic scattering of protons on Ne^{20} are measured at an angle of 90° for incident proton energies between 3.35 and 5.15 Mev. The angular distributions for incident proton energies of 3.65, 4.00, 4.15, and 4.35 Mev are also measured. Variations in the energy dependence of the excitation function and angular distributions indicate the existence of a reaction mechanism involving the formation of a compound nucleus. The data of Heitler et al. regarding the sharp increase of the inelastic scattering differential cross section at angles below 50° are not confirmed. (auth)

11284 INTENSITIES OF γ-TRANSITIONS TO THE GROUND ROTATIONAL BAND IN NEUTRON RESONANCES OF THE $Gd^{155}(n,\gamma)Gd^{156}$ REACTION. L. S. Danelyan, B. V. Efimov, S. K. Sotnikov, and V. Kakhramanov-Dzhazairov. Zh. Eksperim. i Teor. Fiz., 45: 1858-64(Dec. 1963). (In Russian)

The relative values of the intensites of γ transitions at the ground rotational band are measured for 20 resonances in the $Gd^{155}(n,\gamma)Gd^{156}$ reaction with a two-crystal scintillation spectrometer. For the accuracy of the measurements attained in the experiments, the intensity distribution in resonances is consistent with the Porter-Thomas distribution with a channel number $\nu = 1$. However the possibility remains that it consists of two groups of such distributions with various mean values of the intensities. (auth)

11285 DETERMINATION OF THE RATIO OF THE PROBABILITIES FOR ELECTRON CAPTURE AND POSITRON DECAY OF THE Sb^{115} ISOTOPE WITH AID OF A SCINTILLATION γ-SPECTROMETER. N. A. Vartanov. Zh. Eksperim. i Teor. Fiz., 45: 1875-8(Dec. 1963). (In Russian)

A simple method is suggested for determining the ratio of the probabilities of electron capture and positron decay for the case when a γ-line with an energy $\sim m_0c^2$ is present in the spectrum of the investigated isotope. The method is applied for determining the value of ϵ/β^+ for the positron-active isotope Sb^{115} under the assumption that positron decay occurs on the 499-kev excited level of the daughter nucleus of Sn^{115}. The value obtained, $\epsilon/\beta^+ = 1.99$, is in satisfactory agreement with the theoretical value (~1.87). Special attention is paid to the problem of an exact determination of the areas under the total absorption peaks as this is very important in calculating the ratio by the method suggested. The procedure can be realized in practice with no difficulty and does not require intensity calibration of the spectrometer. (auth)

11286 EQUILIBRIUM SHAPE OF NUCLEUS ACCORDING TO THE DROP MODEL WITH VARIABLE SURFACE TENSION. V. M. Strutinskii. Zh. Eksperim. i Teor. Fiz., 45: 1891-9(Dec. 1963). (In Russian)

Results of calculation of symmetric and equilibrium figures of nuclei based on the drop model with a variable surface tension are presented. (auth)

11287 STABILITY OF EQUILIBRIUM STATES OF THE NUCLEUS IN THE DROP MODEL. V. M. Strutinskii. Zh. Eksperim. i Teor. Fiz., 45: 1900-7(Dec. 1963). (In Russian)

The results of an analysis of the stability of symmetric equilibrium shapes of the nucleus with respect to asymmetric variations of the surface are presented. The results of the calculations are compared with the experiments by invoking the quasistatic model of nuclear fission. (auth)

11288 ELECTRON SCATTERING BY LIGHT NUCLEI ACCORDING TO THE GENERALIZED MODEL. B. I. Tishchenko. Zh. Eksperim. i Teor. Fiz., 45: 1940-2(Dec. 1963). (In Russian)

A study is made of scattering of electrons by light nuclei whose charge density can be calculated according to the generalized model. From the expressions presented one can easily determine the form factors that define the cross section for elastic and inelastic electron scattering accompanied by the excitation of rotational levels of nuclei with $Z \leq 20$. The calculations are compared with the experimental data on elastic and inelastic scattering of electrons with excitation of the 1.73-Mev level in the Mg^{24} nucleus. (auth)

11289 COMPOUND ELASTIC SCATTERING IN ELASTIC SCATTERING OF 5.45-Mev PROTONS ON NICKEL ISOTOPES. G. F. Timoshevskii, R. A. Vanetsian, A. P.

Klyucharev, and E. D. Fedchenko (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 45: 1951-3(Dec. 1963). (In Russian)

A method for calculating the differential cross section for compound-elastic scattering is described. Differential cross sections for elastic scattering of 5.45-Mev protons on Ni^{58} and Ni^{60} isotopes are calculated by employing the complex potential optical model. Experimental data in which compound-elastic scattering is taken into account are compared with optical model calculations, and satisfactory agreement is obtained. (auth)

11290 SEMI-EMPIRICAL METHOD FOR CALCULATION OF THE CROSS SECTION FOR ELASTIC SCATTERING OF SLOW ELECTRONS ON ATOMS. L. M. Biberman and G. E. Norman (Moscow Inst. of Energy). Zh. Eksperim. i Teor. Fiz., 45: 1970-7(Dec. 1963). (In Russian)

A method is proposed by which the scattering length and effective range of elastic scattering of electrons on a neutral atom can be determined by isoelectron extrapolation with respect to quantum defects of electrons in ion fields. For the extrapolation such parameters of the model potential are employed that correspond to quantum defects known from experiments. The extrapolation is not performed with respect to Z but with respect to zero values of the quantum defects. As an example the method is applied to determine the cross sections for elastic scattering of electrons on Ar and Ne atoms for energies up to 1 ev. The results obtained are in satisfactory agreement with available experimental data. (auth)

11291 ON A CERTAIN MODEL FOR CALCULATION OF THE EFFECTIVE CROSS SECTIONS FOR EXCITATION OF ATOMS. L. Vainshtein, L. Presnyakov, and I. Sobelman (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 45: 2015-21(Dec. 1963). (In Russian)

A new method for calculation of the effective cross sections for excitation of atoms by electrons is proposed that is based on a model in which the atom + electron system can be described by a comparatively simple wave function with unseparated variables. The method yields results for the 1s−2p and 1s−2s transitions in the hydrogen atom that are in good agreement with experiment. (auth)

11292 ON THE LONGITUDINAL POLARIZATION OF ELECTRONS IN ALLOWED β TRANSITIONS. A. M. Mukhamedzhanov (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 45: 2048-50(Dec. 1963). (In Russian)

Formulas are derived for the longitudinal polarization of β particles in allowed β transitions. Corrections are introduced in the calculations to take into account relativistic matrix elements, including weak magnetism, and also the Coulomb field of the finite size nucleus. Numerical calculations of longitudinal polarization for β decay of In^{114} shows that the corrections decrease the longitudinal electron polarization by several percent compared to $P_\beta = -v/c$. (auth)

11293 NUCLEAR PHYSICS. Roy Weinstein (Northeastern Univ., Boston). Book II of "Nuclear Engineering Fundamentals." New York, McGraw-Hill Book Company, 1964. 234p.

Static nuclear properties, radioactivity, alpha decay, beta decay, the liquid-drop model, nuclear reactions, and nuclear forces are discussed. Future uses of atomic and nuclear physics, controlled thermonuclear reactions, and radioactivity for control are also considered. Appendices on the exponential decay law, radioactivity-series decays, cyclotron-induced activity, and coordinate transformations are included. (C.E.S.)

11294 DYNAMIC NUCLEAR ORIENTATION. Carson D. Jeffries. Interscience Tracts on Physics and Astronomy. New York, Interscience Publishers, 1963. $5.95.

The processes and methods by which nuclear spins coupled with electron spins can be appreciably oriented through excitation of the magnetic resonances of the spin system are discussed. Nuclear spin systems, electron spin systems, and their interactions with each other and with phonons at low temperatures are discussed. Energy levels and magnetic resonance, electron and nuclear spin-lattice relaxation, dynamic orientation with strong hyperfine coupling, the Overhauser effect, dynamic orientation by nuclear-electron dipolar coupling, and polarization of proton targets are considered. (R.E.U.)

11295 ENERGY SPECTRA OF ALPHA PARTICLES FROM THE $Al^{27}(n,\alpha)Na^{24}$ REACTION INDUCED BY 14.8 Mev NEUTRONS. 7p. (CONF-374-2)

From American Physical Society Southeastern Section, Lexington, Ky., Nov. 1963.

The energy spectra of α particles emitted from Al^{27} bombarded by 14.8-Mev neutrons were measured. Essentially all the α particles emitted in the forward hemisphere were detected. A well-resolved α peak was obtained. (C.E.S.)

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Refer also to abstract 11094.

11296 (AD-404520) LINEAR THEORY OF BEAM-PLASMA INTERACTION. Technical Report No. 60. Yu Chin Lim (Michigan. Univ., Ann Arbor. Electron Physics Lab.). Mar. 1963. Contract AF33(657)-8050. 125p. (ORA-5000-6T)

The interaction of a nonrelativistic beam of charged particles with a weakly ionized stationary plasma under the influence of a longitudinal electric field is studied with the use of Boltzmann's equation and Poisson's equation. The problem is divided into two parts, namely the stationary problem of determining the state of the system when the beam is not premodulated and the perturbed problem of determining the deviation from the stationary state when the beam is premodulated by a small signal at the entrance to the interaction region. The stationary problem is solved by finding the stationary distribution functions in terms of the eigenfunctions of the linearized collision integrals. The perturbed problem is solved by the use of the method of characteristics to express the perturbed distribution functions in terms of the stationary distribution functions already found. A method for obtaining the dispersion relation and the signal gain of the system is also given via an explicit expression for the perturbed electric field obtained as a solution of a linear integral equation. (auth)

11297 (AD-407885) ELECTROMAGNETIC PROPERTIES OF PLASMAS. (Diamond Ordnance Fuze Labs., Washington, D. C.). Feb. 24, 1961. 41p.

Apparatus, procedures, and theory to be used in laboratory investigations of the environmental conditions around hypersonic missiles are described. Measurements of microwave propagation, power radiation, and Stark broadening of spectral lines will be made on shock plasmas. Results of preliminary propagation measurements on plasma behind a Mach 8 shock in argon are included. (D.C.W.)

11298 (AFCRL-63-10) GUIDED ELECTROMAGNETIC PROPAGATION ALONG A NON-GYROTROPIC CIRCULAR PLASMA COLUMN. Scientific Report No. 77. V. L. Granatstein and S. P. Schlesinger (Columbia Univ., New York). Oct. 30, 1962. Contract AF19(604)-3879. 34p. (AD-402680)

Guided electromagnetic modes along a homogeneous circular column of plasma imbedded in free space are examined for the two extreme cases of zero and large axial magnetic field. The plasma is assumed to be cold and collisionless and ion motion is negative. For the zero field case, the modes with azimuthal variation are found under certain conditions to exhibit backward wave characteristics, and previously published results of a quasi-static analysis are modified. In the case of a strong magnetic field, the occurrence of unique wave-guiding features is noted. (auth)

11299 (AFCRL-63-259) UNDAMPED WAVES IN A COLLISION FREE ELECTRON PLASMA. Technical Note No. 3. Donald McLean (Paris. Observatoire, Meudon). July 10, 1962. Contract AF61(052)-432. 44p. (AD-403533)

The properties of stable, small amplitude, longitudinal waves in a collision-free electron plasma are investigated. An example of an undamped wave is presented, and the absence of a true dispersion relation for the stable waves is demonstrated. It is shown that collisions probably render highly unstable those waves that do not approximately satisfy the normally obtained dispersion relation. The results of other investigations are considered in relation to the present calculations. (D.C.W.)

11300 (AFSWC-TDR-62-131) AN INVESTIGATION OF PLASMA EM RADIATION INTERACTION. Final Report. S. Katz, C. A. Roberts, and R. S. Wright (Aeronutronic. Div. of Ford Motor Co., Newport Beach, Calif.). Apr. 1963. Contract AF29(601)-4593. 251p. (AD-411260)

The nonequilibrium behavior of an ionized gas whose constituent particles interact through the Coulomb potential and through the transverse modes of the electromagnetic field was studied by two different techniques. The Bogoliubov approach to the study of a many body system was applied to an ionized gas. The governing hamiltonian contains the Coulomb potential and the first nonvanishing contribution of the transverse electromagnetic field in an expansion in powers of the reciprocal speed of light. The diagram method of Prigogine was applied to the full system hamiltonian. The class of diagrams representing the linear electromagnetic field terms and the quadratic electromagnetic field terms in the hamiltonian were identified and analyzed for their parameter dependence. (auth)

11301 (CONF-363-13) AN RF TECHNIQUE FOR PLASMA NUMBER DENSITY MEASUREMENT. F. W. Crawford (Stanford Univ., Calif. Microwave Lab.). Oct. 1963. Contract AT(04-3)-326-1. 37p. (ML-1087)

From International Symposium on Plasma Phenomena, San Diego, Calif., Oct. 1963.

The dipole resonance frequency of a cylindrical plasma column in a transverse r-f electric field can be used to determine the average electron density across the plasma section. The experimental application of the technique to plasma with and without a confining static magnetic field is described, and theoretical curves to facilitate reduction of the data are given. The feasibility of using higher order multiple resonances to determine the density number profile is also discussed. (auth)

11302 (NP-13526) [UNTERSUCHUNG DER ZEITABHÄNGIGKEIT DER EXOELEKTRONENEMISSION]. (Investigations on Time Dependence of Exo-Electron Emission). H. Eckei and E. Huster (Munster, Germany. Universität). [1960]. 43p.

The decay of exo-electron emission from freshly abraded metal surfaces is investigated using a cylindrical Geiger-Muller counter filled with mixtures of argon-alcohol. The emission rates decreased through about three powers of ten during 25 hours. The decay curves were found to be composed of a sum of exponential decays. A graphical method to determine the decay constants is described. It was found that different mixtures of counter gases have no influence on the exo-electron emission. The results are discussed. (auth)

11303 (NP-13539(Paper 3)) CURRENT FLOW BETWEEN ELECTRODES IMMERSED IN A LOW GAS PRESSURE PLASMA. M. J. Kofoid (Boeing Scientific Research Labs., Seattle).

The magnitude of the leakage current through the plasma (no breakdown is expected) was investigated experimentally and theoretically. Electrodes with highly unequal areas and a potential difference of up to 150 volts between them were considered. It was concluded that the current can become appreciable only if the cathode area is large. The current can then become large only if anode conditions permit. (D.C.W.)

11304 (SIT-110) PLASMA PHYSICS. LECTURE NOTES, CHAPTER VII. HYDROMAGNETIC STABILITY. George Schmidt (Stevens Inst. of Tech., Hoboken, N. J.). 1963. Contract AT(30-1)-2813. 65p.

Stability criteria for hydromagnetic systems are obtained using both the energy and motion approaches, and the stability of magnetically confined configurations is investigated. Investigation of oscillations around equilibrium with the motion equation gives the equations of the Alfven and magnetoacoustic waves in an infinite fluid in a magnetic field. (D.C.W.)

11305 (TID-20055) STUDIES OF PLASMA OSCILLATIONS. Quarterly Status Report No. 16, September 1–November 30, 1963. (Stanford Univ., Calif. Microwave Lab. and Stanford Univ., Calif. W. W. Hansen Labs. of Physics). Dec. 1963. Contract AT(04-3)-326. 21p. (ML-1126)

Theory for beam-plasma interactions, taking electron temperature into account, was developed further. The dispersion relations, gain, and growth and propagation constants were calculated for an infinite charged particle beam streaming through an infinite plasma. Experimentally, studies of ion waves, double sheaths at tube constrictions, and factors affecting beam breakup were continued. (D.C.W.)

11306 (USCEC-96-101) RESEARCH IN PLASMA AND MAGNETOHYDRODYNAMICS. Zohrab Kaprielian (University of Southern California, Los Angeles). Mar. 1963. 16p. (EE-21; AD-413768)

Theoretical and experimental investigations on electromagnetic radiation from a dipole in an anisotropic plasma, plasma diagnostics, plasma parametric amplifiers, thermal radiation from a highly-ionized current-carrying plasma, and penning discharge plasma sources are briefly reviewed. (D.C.W.)

11307 EXPERIMENTS WITH AN ELECTRON CYCLOTRON RESONANCE PLASMA ACCELERATOR. David B. Miller and Edward F. Gibbons (General Electric Co., King of Prussia, Penna.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 35-41(Jan. 1964).

A plasma acceleration system is described in which power is transferred from an r-f electromagnetic field to a flowing plasma by means of electron cyclotron resonance coupling. An efficient coupling of energy from the r-f field to the plasma can be expected if a right-hand, circularly polarized wave is used and if the flow conditions of the injected gas are properly established. The Lorentz force due to the radial component of the fringing magnetic field then converts the electron paths from transverse to longitudinal, and the resulting charge-separation field causes the ions to follow. Experimental results obtained with a medium power (320 w), S-band microwave accelerator are presented. Plane rather than circularly polarized waves are used in this system. In spite of this, the coupling of energy from the r-f field into the plasma can be made to be quite good; efficiencies on the order of 80–90% were measured. The r-f plasma interaction zone is rather narrow in this experiment, thereby not making efficient use of the injected gas. As much as 22% of the incident r-f power appears in the accelerated plasma stream, however. The effects of magnetic field strength, gas density, and gas injector location on exhaust stream characteristics, r-f plasma interaction zone thickness, and r-f reflection coefficient are described. Design considerations resulting from these experiments are discussed. (auth)

11308 COULOMB COLLISIONS, AND OTHER ELASTIC COLLISIONS, IN PLASMAS. J. M. Dolique. Ann. Radioelec., 18: 167-203(July 1963). (In French)

The microscopic and macroscopic descriptions of elastic collisions acting on the state of the plasma are discussed. Application is made to strongly ionized, long lifetime plasma, or weakly ionized plasma where effects of collisions are important with a view to electrical propulsion or MHD conversion. (R.E.U.)

11309 MACROSCOPIC EXCHANGES OF MOMENTUM AND ENERGY BETWEEN ELECTRONS AND IONS, BY COLLISIONS, IN PLASMA FLOWS. J. M. Dolique. Ann. Radioelec., 18: 204-15(July 1963). (In French)

Macroscopic exchanges of momentum and energy between electrons and ions in a plasma flow are effected through macroscopic electric and magnetic fields and by Coulomb collisions. A general method is developed for calculating the terms of exchange by collisions: P_{ab} and R_{ab}, momentum and energy, respectively, given up by fluid b to unit volume of fluid a, in unit time (a, b= electrons or ions). Various applications are considered: electrical conductivity of a plasma with hot ions ($T_i \gg T_e$), and nonlinear electrical conductivity of a plasma in which the electron-ion drift velocity is not infra-sonic. (auth)

11310 MOTION OF SINGLE CHARGED PARTICLES IN A MAGNETIC FIELD WITH A HELICAL SYMMETRY. V. M. Balebanov, B. I. Volkov, V. B. Glasko, A. L. Groshev, V. V. Kuznetsov, A. G. Sveshnikov, and N. N. Semashko. At. Energ. (USSR), 15: 409-10(Nov. 1963). (In Russian)

The possibility of stabilizing a plasma within a trap provided with magnetic probes by means of stellarator-type helical windings, was examined. As opposed to the toroidal-type stellarator, in this type of trap with open ends stability may be achieved only as the result of drift of the particles; the direction of the drift is opposite to that of the rotation of the particles. The motion of a particle injected into the magnetic field formed by threefold spiral windings was examined; the longitudinal field was kept thereby homogeneous. The equation derived indicated that in the central region the particles move along surfaces which at small Larmor radii coincide with the magnetic surfaces circling the axis. The sign of the azimuthal drift may be determined if the dependence of the magnetic field on the coordinate is known. In the case of small radii, the field grew radially in some azimuths and decreased in others. The calculations indicated that in a field with helical symmetry within the separatrix, the field drift occurs only if the particles have large Larmor radii and then only for a small injection angle. Therefore, at small Larmor radii, there is no stabilizing effect. (TTT)

11311 TOROIDAL MAGNETOHYDRODYNAMIC STABILITY. Ludwig Biermann (Max-Planck-Institut für Physik und Astrophysik, Munich). Cahiers Phys., 17: 41-7(Jan. 1963). (In French)

Some studies of the stability of plasma tori in equilibrium are reviewed, and one recent study based on the energy principle is outlined. (D.C.W.)

11312 KINETIC THEORY OF VISCOSITY IN COMPLETELY IONIZED GASES. Henri Cabannes (Faculté des Sciences, Paris). Cahiers Phys., 17: 131-40(Mar. 1963). (In French)

A gas in which the electron masses are negligible in relation to the ion masses is considered. The velocity distribution function is developed in a series of Sonine polynomials, and the pressure tensor is derived. For the case of no magnetic field, the coefficient of classical viscosity appears; but for non-zero magnetic field, five coefficients of viscosity appear. Calculation of the first three approximations for interaction of hard elastic spheres and coulomb interaction showed good convergence. (D.C.W.)

11313 NON-LINEAR EFFECTS IN PLASMA OSCILLATIONS. Kiyoshi Ogawa and Kenya Matsuura (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 27: 615-20 (Aug. 1963).

An extension of the quasilinear theory and the perturbational treatment of the nonlinear terms in the fundamental equation is presented. A general expression of the nonlinear effects in plasma oscillation is given by calculations starting from the Landau-Vlasov and the Poisson equations. A key to the analysis of this general expression is on the basis of Hamiltonian formalism. The mode-coupling of plasma oscillations is discussed in detail in connection with the damping of plasma oscillations. (atuh)

11314 TWO MILLIMETERS WAVE DENSITY METER FOR HIGH TEMPERATURE PLASMA ELECTRONS. Shigeo Asai and Shintaro Kotani (Oki Electric Industry Co., Ltd., Japan). Erekutoronikusu, 8: 944-7(Aug. 1963). (In Japanese)

An interferometer with a 2-mm-wave oscillation source was manufactured for trial for measuring the density of high-temperature plasma electrons. The mechanisms of the frequency multiplier and characteristics of the diode and the multiplier are described. Exchange of the diode in the multiplier is easy, and its frequency characteristic is good. The wave guide for the multiplier is made of two channeled oxygen-free copper parts welded by pressure in nitrogen gas. A matching transformer for 2-mm wave output is used for increasing multiplying efficiency. The crystal for the diode is P-type silicon with 0.02% impurity (boron) and a specific resistance of 0.5 ~ 0.05 Ω cm. The characteristics of the multiplier and detector together were obtained. Conversion loss was 20 db and the output of the multiplier was 300 μw. The density of the steady discharge plasma was measured with the multiplier manufactured for trial, with other microwave circuit elements, and with PIG

discharge equipment. (Nucl. Sci. Abstr. Japan, Vol. 2, No. 4)

11315 THE DISTRIBUTION OF PARTICLES IN A CENTRALLY SYMMETRIC FIELD. A. V. Gurevich (Lebedev Inst. of Physics, Moscow). Geomagnetism Aeronomy, 3: 151-64(1963).

Expressions were derived and analyzed for the density and flux of particles in a rarefied gas in a centrally symmetric field. The absorption of particles at the surface of a body is considered. (auth)

11316 CONSTITUTIVE EQUATIONS FOR A PLASMA-LIKE MEDIUM. Jacob Neufeld (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 34: 2549-52(Sept. 1963).

A general formulation is obtained representing the constitutive equations for a plasma-like medium. These equations are of the type $P = \alpha_{ee} E + \alpha_{em} B$; $M = \alpha_{me} E + \alpha_{mm} B$, where E is the electric intensity, B is the magnetic induction, P and M represent the electric and magnetic polarizations, respectively, and α_{ee}, α_{em}, α_{me}, and α_{mm} are appropriate macroscopic parameters characterizing the medium. These equations differ from the constitutive equations for a molecular medium since in the latter case one has $P = \chi_e E$ and $M = \xi_m B$, where χ_e is the electric susceptibility and ξ_m is the proper magnetic susceptibility. A formulation is given for the constitutive parameters for two particular cases: when the plasma-like medium is represented by a charge-equilibrated uniform electron beam of infinite width and when the plasma-like medium is represented by a charge-equilibrated electron gas characterized by an isotropic velocity distribution. (auth)

11317 MICROWAVE REFLECTION FROM SMALL-DIAMETER PLASMA COLUMNS. R. A. Stern (Bell Telephone Labs., Whippany, N. J.). J. Appl. Phys., 34: 2562-5 (Sept. 1963).

The scattering cross section of electromagnetic waves incident normally on a small-diameter plasma column exhibits resonances as a function of plasma density when the waves are polarized at right angles to the axis of the column. The electron density at resonance was measured, using a microwave cavity technique, in pulsed helium arc discharges, as the frequency of the incident microwaves was varied from 2 to 4 kMc. At resonance, the squared-ratio of plasma frequency to incident frequency is found to be independent of frequency and neutral gas pressure, but somewhat dependent on pulse duration. Results are in qualitative agreement with recent analyses of the interaction between electromagnetic fields and thermal plasmas with finite dielectric boundaries. (auth)

11318 ELECTRICAL CONDUCTIVITY OF CESIUM-SEEDED ATMOSPHERIC PRESSURE PLASMAS NEAR THERMAL EQUILIBRIUM. Lawson P. Harris (General Electric Research Lab., Schenectady, N. Y.). J. Appl. Phys., 34: 2958-65(Oct. 1963).

Measurements were made of the electric conductivities of gaseous mixtures formed by the addition of small fractions of cesium vapor to nitrogen, helium, neon, or argon. The mixtures were maintained near thermal equilibrium at temperatures in the 1500 to 2000°K range and a total pressure of one atmosphere. The cesium vapor pressures ranged over two decades, from 0.1 to 10 torr. The apparatus consists, in essence, of two heated zones connected by a slow flow. The first zone is a low-temperature (200 to 400°C) oven where the body-gas flow picks up the cesium vapor. The second zone is a small electrically heated furnace (1250 to 1850°C) containing a diode test section. The principal measurements taken were the seeding temperature, furnace temperature, and voltages and currents in the test section. The results exhibit variations with temperature, seeding pressure, and gas species that correlate reasonably well with simple theory and values for electron collision frequencies and cross sections taken from the literature. (auth)

11319 HIGH-POWER LOW-DENSITY INDUCTION PLASMAS. Thomas B. Reed (Massachusetts Inst. of Tech., Lexington). J. Appl. Phys., 34: 3146-7(Oct. 1963).

The behavior of high-power (thermal) induction plasma of helium, neon, and argon operating in the pressure range of 10μ to 1 atm was investigated and their spectra photographed. The behavior of high-power plasma was compared with low-power (cold) plasma and plasma produced in Geisler tubes. (C.E.S.)

11320 VALIDITY OF PLASMA TEMPERATURES OBTAINED FROM EMISSION LINES OF SEEDED METAL ATOMS. Ray Hefferlin (Southern Missionary Coll., Collegedale, Tenn.) and Carl A. Rouse. J. Opt. Soc. Am., 54: 266-7(Feb. 1964).

The temperature change in a plasma-jet flame due to addition of seed metal atoms was investigated. The energy density as a function of temperature was studied for argon seeded with 0 to 2% iron, and argon-cesium mixtures of 100 : 0 to 0 : 100; the temperatures were 0.2 to 3.0 ev and mass densities were 10^{-6} to 10^{-2} g/cc. (R.E.U.)

11321 CORRECTION FOR THE TOROIDAL JOULE HEATING WINDINGS OF PLASMA DEVICES. Akihiro Mohri (Kyoto Univ.), Hiroshi Oshiyama, Shigenori Hayashi, and Seiichi Ariga. Japan J. Appl. Phys., 2: 815-16(Dec. 1963).

The field deformation from the Joule heating windings of a toroidal discharge tube is discussed and corrections are suggested. (R.E.U.)

11322 MAGNETIC COMPRESSION OF TOROIDAL PLASMA. PART I. Tadashi Kawai and Hiromichi Kondo (Mitsubishi Electric Co., Japan). Kakuyugo-Kenkyu, 11: 191-221(Aug. 1963).

The possibility of confining the plasma in a toroidal shape by means of an axial magnetic field with a high rate of rise was examined. The plasma column was pre-heated with the induced axial current by ohmic heating before it was adiabatically compressed. A glass torus of 600 mm major and 120 mm minor diameters was used. The plasma machine was carefully designed to provide a high degree of uniformity of the electromagnetic field in the torus. The plasma of air and He was constricted to about $\frac{1}{3}$ of the torus inner diameter, around the center axis for 10 to 20 μS, and after that the drift of the column due to the charge separation was observed to drive it toward the wall. The temperature was estimated from the plasma conductivity to be as high as 100,000 to 200,000°K. Magnetic probe and spectroscopic diagnostics were also applied. Discussions of designing considerations about the plasma machine and results of electrical measurements with streak photographs of the plasma appearance are given. The results of magnetic probe measurements and the spectroscopic investigations are being prepared for publication. (auth)

11323 ON THE THEORY OF THE RECIPROCAL EFFECTS OF CHARGED PARTICLES WITH THE TOTALITY OF PLASMA ELECTRONS. W. Kaufmann (Institut für Magnetohydrodynamik, Deutsche Akademie der Wissenschaften, Jena, Ger.). Monatsber. Deut. Akad. Wiss. Berlin, 5: 248-52(1963). (In German)

The hydrodynamic method was used in the consideration of plasma. The density distribution of plasma electrons in

plasma produced by a point charge was studied. Formulation of the production equation is presented. Longitudinal plasma waves and reactions of the plasma-electron continuum on the test particle are discussed. (M.C.G.)

11324 A PLASMA JET GENERATOR FOR SUPERSONIC VELOCITY. W. Boldt (Physikalich-Technisches Institut, Deutsche Akademie der Wissenschaften, Berlin). Monatsber. Deut. Akad. Wiss. Berlin, 5: 350-4(1963). (In German)

An experimental apparatus for production and observation of a plasma jet with supersonic velocity was developed. Its mode of action and design is described. The optical image of the plasma jet is shown. (M.C.G.)

11325 ON THE DETERMINATION OF TEMPERATURE IN HIGH-TEMPERATURE XENON PLASMA FROM THE SELF-REVERSAL OF SPECTRAL LINES. U. Kopec (Forschung und Entwicklung, VEB Berliner Gluhlampenwerk). Monatsber. Deut. Akad. Wiss. Berlin, 5: 395-7 (1963). (In German)

Temperature determinations were made in high-pressure xenon arcs by measuring self-reversals of spectral lines. Values of 9500°K for the cathode spot and 7700°K for the arc center were obtained. (M.C.G.)

11326 ON THE INFLUENCE OF EXTERNAL SHORT-CIRCUIT RING ON CYLINDRICALLY CONVERGING MAGNETOHYDRODYNAMIC SHOCK WAVES. L. Rothhardt (Institut für Magnetohydrodynamik, Deutsche Akademie der Wissenschaften, Jena, Ger.). Monatsber. Deut. Akad. Wiss. Berlin, 5: 435-7(1963). (In German)

Time-resolution photographs of the radial luminous phenomena from shock waves hitting the side of the discharge chamber were made. The effects of a short-circuit ring were studied. (M.C.G.)

11327 ELEMENTARY MAGNETOHYDRODYNAMIC TREATMENT OF CHAOTIC TURBULENT MEDIA. M. Steenbeck (Institut für Magnetohydrodynamik, Deutsche Akademie der Wissenschaften, Jena, Ger.). Monatsber. Deut. Akad. Wiss. Berlin, 5: 625-9(1963). (In German)

It is shown that some elementary calculations of a chaotic turbulence are possible. Chaotic turbulence is defined. Lowering of the electric conductivity and magnetic permeability of a fluid by the turbulence is discussed. (M.C.G.)

11328 RADIATION FROM PLASMAS, WITH SPECIAL EMPHASIS ON COHERENT RADIATION. H. G. van Bueren (Philips' Gloeilampenfabrieken, N. V., Eindhoven, Netherlands). Ned. Tijdschr. Natuurk., 29: 154-71(May 1963). (In Dutch)

A review is given of the physical background of the spectroscopic analysis of plasmas. The practical importance of the spectroscopic analysis of plasmas in thermonuclear studies was illustrated with a contaminated completely ionized plasma as an example. The processes such as stimulated emission and optical pumps are described, with the utilization of optical masers or laser given as illustration. (J.S.R.)

11329 PROPERTIES AND UTILIZATION OF CESIUM PLASMAS. J. C. Terlouw (FOM-Instituut voor Plasmafysica, Rijnhuizen, Jutphaas, Netherlands). Ned. Tijdschr. Natuurk., 29: 209-18(June 1963). (In Dutch)

Some of the properties of cesium plasmas that make them of value in basic studies are described. The low ionization potential, large collision cross section, Maxwell velocity distribution, and "pure" discharges are the properties discussed. The utilization of cesium plasma in the study of surface-ionized plasmas and arc discharges is given as illustration of their use. The study of the properties of strongly ionized cesium plasmas offers insight into the processes playing roles in completely ionized plasmas. (J.S.R.)

11330 ELEMENTARY PROCESSES IN GAS DISCHARGES. J. A. Smit (Rijksuniversiteit, Utrecht). Ned. Tijdschr. Naturrk., 29: 227-45(July 1963). (In Dutch)

The review of elementary processes in gas discharges is limited to low energies, to recent results, and to some characteristic examples. The significance of these processes in scattering and radiation phenomena is indicated. Transition probabilities, optical excitation functions, ionization functions, and cathode sputtering are the topics discussed. (J.S.R.)

11331 PLASMA AND ITS APPLICATIONS. E. Schatzman (Faculté des Sciences, Paris). Onde Elec., 43: 748-51(July-Aug. 1963). (In French)

The basic principles that govern the use of plasma in various applications; energy conversion, generation of movement, production of order out of disorder, wave propagation, and microscopic phenomena are discussed. (auth)

11332 SIMPLE VARIATIONAL BOUND TO THE ENTROPY. G. H. Derrick (Univ. of New South Wales, Kensington, Australia). Phys. Rev., 133: A1215-17(Mar. 2, 1964).

The following variational principle is obtained for the entropy S(E) of a system with energy E: $S(E) \geq -k \ln (\text{Trace } U^2)$ for all non-negative Hermitian density matrices U with Trace U = 1, Trace HU = E; H is the hamiltonian and k is Boltzmann's constant. The equality sign is realized with this principle for the density matrix of the microcanonical ensemble, as well as for a wide class of similar ensembles (in the limit of large volume). (auth)

11333 PLASMA INSTABILITY IN THE WHISTLER MODE CAUSED BY A GYRATING ELECTRON STREAM. T. F. Bell and O. Buneman (Stanford Univ., Calif.). Phys. Rev., 133: A1300-2(Mar. 2, 1964).

Excitation of the whistler (electromagnetic) mode in a cold plasma immersed in a static magnetic field cannot be achieved by monoenergetic electrons initially streaming parallel to the field lines, since for this case gyroresonance can occur only when the stream direction is opposed to the direction of the wave, and as demonstrated by Neufeld, the beam will then fail to transfer energy to the wave. However, for streams with finite initial transverse velocity the analysis of Neufeld must be modified, and it is found that a spread of stream electron velocity in the transverse direction leads to an instability of the stream-plasma system in the whistler mode, with the transverse electron gyrations serving as an energy source. An estimate of phase mixing through longitudinal velocity spread shows that the phase-mixing effect can suppress the electrostatic instability without suppressing whistler growth. Streams approaching magnetic mirror points can develop high enough gyratory energies to cause whistler excitation, and under typical ionospheric conditions indicating the presence of electron streams, whistler growth rates are calculated that could explain recent observation of very low frequency emissions. (auth)

11334 NEGATIVE ABSORPTION DUE TO COULOMB SCATTERING OF AN ELECTRON STREAM. Toshimitsu Musha and Fujio Yoshida (Electrical Communication Lab., Tokyo). Phys. Rev., 133: A1303-7(Mar. 2, 1964).

Radio-frequency electric conductivities are calculated with electrons drifting through an ion cloud under an externally applied static electric field. The stationary velocity distribution of electrons is taken to be a displaced Maxwellian. Then, if the drift velocity is larger than 0.8 times the electron velocity spread, the real part of the electric conductivity becomes negative at frequencies much higher than the mean-collision frequency. (auth)

11335 INCOHERENT SCATTERING OF RADIATION BY PLASMAS. I. QUANTUM MECHANICAL CALCULATION OF SCATTERING CROSS SECTIONS. D. F. DuBois (Hughes Research Labs., Malibu, Calif.) and V. Gilinsky. Phys. Rev., 133: A1308-16(Mar. 2, 1964).

The quantum electrodynamics of the scattering of radiation from an interacting, fully-ionized plasma is treated. The theory includes the effects of quantum statistics and is valid to all orders in many-particle perturbation theory. The scattering cross section is related to the partial conductivities of the interacting system. This reduces the problem of the inclusion of close Coulomb collisions, which lie outside of previous random-phase approximation calculations, to the calculation of collision corrected conductivities. The theory is applicable to degenerate quantum plasmas as well as to classical plasmas. (auth)

11336 INCOHERENT SCATTERING OF RADIATION BY PLASMAS. II. EFFECT OF COULOMB COLLISIONS ON CLASSICAL PLASMAS. D. F. DuBois (Hughes Research Lab., Malibu, Calif.) and V. Gilinsky. Phys. Rev., 133: A1317-22(Mar. 2, 1964).

Random-phase approximation calculations on the incoherent scattering of electromagnetic waves from a classical plasma are extended to include the effects of collisions. The high-frequency plasma line is found to be significantly broadened by collisions. For most practical applications (e.g., ionosphere scattering) the cross section at the low-frequency ion acoustic mode is not changed very much from the RPA prediction. However, in a highly collision-dominated situation, when the frequency of the acoustic mode is well below the ion-ion and electron-electron collision frequencies, this low-frequency resonance is significantly sharpened while the zero-frequency cross section is compensatingly reduced. (auth)

11337 CRITERION FOR STABILITY AGAINST RESISTIVE INTERCHANGE MODES. Bruno Coppi (Princeton Univ., N. J.). Phys. Rev. Letters, 12: 6-9(Jan. 6, 1964). (MATT-220)

A cylindrical pinch configuration is considered, and it is shown that if $\beta = 2p/B^2$ is of the same order of magnitude as $p'R/B^2$ and small, a criterion for stability against resistive interchange can be given, where p is the pressure, p′ its gradient, B the total magnetic field, and R the radius of the plasma cylinder. (R.E.U.)

11338 LABORATORY OBSERVATIONS OF MAGNETOHYDRODYNAMIC SHOCK WAVES. George C. Vlases (California Inst. of Tech., Pasadena). Phys. Rev. Letters, 12: 43-5(Jan. 13, 1964).

Verification of the differences between the flow when the gas is initially cold and when it is appreciably conducting is presented from observations in a magnetically driven shock tube of the inverse pinch type. Experiments were conducted at several pressures in argon and helium. It is concluded that in the presence of strong preheating, the compression zone displays true MHD characteristics with strong coupling between the gas and electromagnetic fields. (R.E.U.)

11339 MICROWAVE INTERFEROMETER FOR STUDYING RAPIDLY FLUCTUATING PLASMAS. L. C. Robinson (Univ. of Sydney). Rev. Sci. Instr., 35: 226(Feb. 1964).

A standing-wave interferometer with rapid response and the ability to determine the direction of density changes in plasma is described. In the instrument the reference traveling wave and the probing traveling wave that passes through the plasma are propagated through a waveguide in opposite directions, thereby producing a standing-wave interference pattern that is sampled by two standing-wave probe units and displayed on a double-beam oscilloscope. (C.E.S.)

11340 EXPERIMENTAL RESEARCH ON ELECTRIC PROPULSION. NOTE VI. ANALYSIS OF THE PERFORMANCE OF THREE DIFFERENT, ELECTROMAGNETICALLY STABILIZED ARCOJETS. Aurelio C. Robotti and Mario Oggero (Scuola di Ingegneria Aerospaziale, Turin). Ric. Sci., Rend., Sez. A, 3: 865-72(Sept. 1963). (In Italian)

Experiments on three different types of arc-plasma jets are described. The propulsive characteristics were determined with a view to hypothetical uses in space. Calorimetric measurements were carried out. Kinetic-electrical performance averaged 30%. (auth)

11341 PLASMA INVESTIGATIONS BY MEANS OF PROBES. Yu. M. Kagan and V. I. Perel. Usp. Fiz. Nauk, 81: 409-52(Nov. 1963). (In Russian)

The probe method is based on the fact that a small spherical, cylindrical, or flat electrode, placed in a given spot within a discharge, assumes a higher or lower potential u_0 than the potential of the plasma at the same spot. The potential difference between u_0 and the plasma potential generates an electric field in the surrounding volume that accelerate or repel charges, depending on their sign. During the measurement the probe may be connected to an anodic or cathodic potential. The total current on the probe is composed of the ionic and the electron currents. The Langmuir probes represent a reliable tool for investigating isotropic low-pressure plasma at sufficiently low magnetic fields. They may be employed at pressures at which the mean free path of the plasma particles is shorter than the length of the probe. Plasma parameters were successfully measured in Hg and rare gases at pressures ranging from 1 to 20 mm of Hg. The directed motion of electrons distorts the characteristics of the probe in the discharge volume; in the absence of an acceptable theory, this problem remains unsolved for the present. Similarly, the probe method cannot be used for the study of strong magnetic fields. If the electron velocity distribution in the system is not strictly Maxwellian, discrepancies may be observed in energy ranges, within which inelastic collisions may take place; therefore the methods used for determining the electron distribution functions must be further improved, especially in the high-energy range. One hundred twelve references are given. (TTT)

11342 PLASMA EQUILIBRIUM MODELS UNDER SURFACE TENSION. A. Ya. Voronov. Vestn. Mosk. Univ., Ser. III, Fiz., Astron., No. 5, 43-8(Sept.-Oct. 1963). (In Russian)

Stability and equilibrium in an elongated ellipsoidal plasma model subjected to surface tension by a thin ionized layer were analyzed in hydrodynamic approximation. (tr-auth)

11343 DEIONIZATION OF STEADY-STATE PLASMA FLUX CONSIDERING VARIATIONS IN ELECTRON TEMPERATURE. O. R. Konenko. Vestn. Mosk. Univ., Ser. III, Fiz., Astron., No. 5, 90-5(Sept.-Oct. 1963). (In Russian)

Plasma flux deionization by ambipolar diffusion, considering electron temperature variations, was approximated. It is shown that an electron temperature gradient is equivalent to an accelerated plasma flux, resulting in a reduced

concentration of charge carriers along the flux axis. (tr-auth)

11344 OBSERVATIONS AND INVESTIGATIONS OF HIGH-FREQUENCY PLASMA FLAMES. U. Jecht and W. Kessler (Technische Hochschule, Munich). Z. Anal. Chem., 198: 27-35(1963). (In German)

The design of a high-frequency electronic torch operating at 2400 mc and some of the physical characteristics of this discharge are described. The electrons wanted for the discharge seem to come from the plasma and not from the electrode. Investigations were made with several gases, flow rates, and power inputs. It was found that the torch works best with nitrogen because of the metastables of this gas. An extensive examination was made of the spectrum from about 2,000 to 7,000 Å. The temperature of the gas was found to be of the order of 4,000°K. (auth)

11345 DYNAMIC PROPERTIES OF ELECTRIC DISCHARGES IN THERMAL PLASMAS. Hans-Juergen Hentschel (Technische Hochschule, Karlsruhe, Ger.). Z. Angew. Phys., 16: 369-77(Nov. 1963). (In German)

A theory of the strongly radiating, modulated arc was formulated on the basis of the canal model as stated by Weizel, Rompe, and Schulz. The role of the heat leakage was extensively investigated, and the variability of the canal radius with the modulation, designated as pulsing of the canal, was introduced into the theory. From the laws of the heat wave, the behavior of this pulsing is completely dependent on the frequency of the arc. The theory was quantitatively tested on a Xe high-pressure arc. Satisfactory agreement was found when the assumption was made, for the dynamic behavior of the cathode drop, that an alternating voltage requirement increasing with the frequency was necessary in order to cover the losses through heat output and heat capacity of the cathode. A possibility is offered to obtain from dynamic studies of the cathode drop data for a cathode drop theory. The theory confirms that the dynamic behavior of arcs in thermal plasmas is determined only by the thermal properties of the plasma and the power concentration in the arc. The inertia of an arc becomes lower as the power concentration increases and becomes larger as the heat capacity and nonstationary heat leakage increase. The theory developed gives a relatively clear relation between general physical data of strongly radiating arcs and their dynamic behavior. The Frie theory gives a closed expression for the alternating-current properties of weakly radiating or nonradiation arcs. From the canal model it can be shown that in spite of approximations, the solution is quantitatively useful. (tr-auth)

11346 ON THE STABILITY OF A SOLUTION IN HYDROMAGNETICS IN THE PRESENCE OF DISSIPATIVE FORCES. J. N. Kapur and R. K. Jain (Univ. of Delhi). Z. Astrophys., 52: 110-17(1961).

The stability of the solution $u = H/\sqrt{4\pi\rho}$ (0, r/p, 1) of the equations of hydromagnetics in the presence of dissipative forces is discussed. It is also shown that Rosenbluth and Longmire's criterion for stability is, in general, not applicable to a dynamical equilibrium. (auth)

11347 DISTRIBUTION OF SPECTRAL LINES OF NEUTRAL NITROGEN THROUGH MICROFIELDS. Albrecht Stampa (Universität, Kiel). Z. Astrophys., 58: 82-92(1963). (In German)

In the wall-stabilized nitrogen-arc plasma with axial temperatures between 12,000 and 14,000°K, profiles, half-widths, and distributions of nitrogen-atom lines at definite electron densities and temperatures were measured and compared with theoretical results. Good agreement with the quantum mechanical calculations of H. Griem was obtained. (tr-auth)

11348 DISTRIBUTION OF SPECTRAL LINES OF NEUTRAL OXYGEN THROUGH MICROFIELDS. Martin Jung (Universität, Kiel). Z. Astrophys., 58: 93-9(1963). (In German)

In wall-stabilized oxygen-arc plasma with axis temperatures between 12,000 and 14,000°K, profiles, half-widths, and distributions of oxygen-atom lines at definite electron densities and temperatures were measured and compared with theoretical results. The observations corresponded to the quantum mechanical calculations of H. Griem. (tr-auth)

11349 PROPERTIES OF MAGNETOPLASMA WAVES IN BISMUTH SINGLE CRYSTALS. M. S. Khaikin, L. A. Falkovskii, V. S. Edelman, and R. T. Mina (Inst. of Physics, Academy of Sciences, USSR and Inst. of Physics, Erivan). Zh. Eksperim. i Teor. Fiz., 45: 1704-16(Dec. 1963). (In Russian)

Magnetoplasma electromagnetic waves with a frequency of 9.5 and 25 G propagating in bismuth at helium temperature and in a magnetic field of 0.5–10 kOe are investigated experimentally and theoretically. The qualitative characteristics of the waves are related to the energy spectrum of the current carriers in bismuth. (auth)

11350 A SPECTROSCOPIC INVESTIGATION OF A TURBULENTLY HEATED PLASMA. S. P. Zagorodnikov, G. E. Smolkin, and G. V. Sholin. Zh. Eksperim. i Teor. Fiz., 45: 1850-7(Dec. 1963). (In Russian)

A turbulently heated helium plasma was investigated by photography of time-resolved spectra with aid of an image converter. The character of penetration of waves in a plasma during turbulent heating is studied in the light of separate spectral lines. The electron temperature is estimated from the intensity of the spectral lines. In a plasma with a density $n_e = 2 \cdot 10^{13}$ cm^{-3} the temperature is T_e = 100 ev. It is shown that under typical experimental conditions the amount of impurities in the plasma did not exceed 1% of the main component. (auth)

11351 RESONANCE PROPERTIES OF INHOMOGENEOUS PLASMA OBJECTS. V. B. Gildenburg (Gorky State Univ., USSR). Zh. Eksperim. i Teor. Fiz., 45: 1978-87 (Dec. 1963). (In Russian)

Oscillations excited by a varying electric field in plasma objects with diffuse boundaries are considered. The thickness of the transition plasma interface is assumed much greater than the Debye radius. Resonance properties of an inhomogeneous plane layer and also of radially inhomogeneous spheres and cylinders with piecewise-linear distribution of the electron concentration are investigated. It is shown that strong damping of plasma waves in the region in which the dielectric constant $\epsilon \sim 1$, strongly lowers the quality factor of the fundamental dipole resonance (the frequency of which depends on the geometrical shape of the object) and leads to complete disappearance of the proper plasma resonances ($\epsilon \approx 0$) for a cylinder and sphere. (auth)

11352 QUANTUM OSCILLATIONS AT HIGH TEMPERATURES. M. Ya Azbel'. Zh. Eksperim. i Teor. Fiz., 45: 2022-3(Dec. 1963). (In Russian)

It is shown that, generally speaking, on the single parameter family of cross sections with self intersection there exist quantum oscillations that are not small at temperatures that are large compared with the distance between the Landau levels. (auth)

11353 PLASMA WAVES. J. F. Denisse and J. L. Delcroix. Interscience Tracts on Physics and Astronomy, No. 17. Translated from the French by Marcel Weinrich

and David J. BenDaniel. New York, Interscience Publishers, 1963. 153p. $7.75.

An integrated study of waves in plasmas is presented. General equations for interactions of electromagnetic fields and particles are given. The dispersion relation for four distinct modes of adiabatic oscillations; ordinary, extraordinary, electron, and ion waves, is derived. The properties of transverse and longitudinal electromagnetic waves, with transverse magnetic field $B_T = 0$, are discussed separately. Classification criteria for plasmas and waves are presented. The four modes of propagation are discussed for the general case of $B_T \neq 0$. The degeneration of the modes of propagation is described for propagation perpendicular to magnetic field ($B_L = 0$). The propagation of waves is studied for cold plasma, i.e., no thermal motion of particles. The speed of propagation and polarization of magnetodynamic waves are discussed. The conductivity tensor and eigenvalue dispersion relation are solved. (R.E.U.)

11354 ON COOLED ANODES IN CONTACT WITH LAMINAR ARC-HEATED FLOWS. Harris B. McKee, Robert C. Dean, Jr., and Agnar Pytte (Darmouth Coll., Hanover, N. H.). 75p. (CONF-102-34)

From American Society of Mechanical Engineers 1963 Winter Meeting, Philadelphia, Nov. 1963.

The physics and operating characteristics of cooled anodes in contact with an arc-heated laminar plasma flow in a constant-area duct are discussed. Various modes of anode behavior are identified and described. Some influences of gas type, flow rate, arc current, anode material, and geometry are demonstrated. A theory is developed to explain the low-current mode of the anode characteristics. It is shown that the local current density on the anode surface is related approximately to the surface's local bias relative to its electrically floating voltage. Anode current distribution data are presented; the distribution is shown to be unstable above a transition bias voltage, with the current concentrating intensely on the edge of the anode toward the cathode. Neighboring points on the duct wall are shown to be electrically independent. This fact greatly simplifies an interpretation of anode phenomena. The information presented makes a fairly complete picture of the physical behavior of finite-length, cooled anodes in contact with fully-developed laminar plasma-arc flows. (auth)

11355 ANOMALOUS QUASI Te_{11} MODE ABSORPTION IN THE AFTERGLOW OF A POSITIVE COLUMN. M. Mentzoni, R. Row, and C. Montgomery (Sylvania Electric Products Inc., Waltham, Mass.). 30p. (CONF-363-14)

From International Symposium on Plasma Phenomena, San Diego, Calif., Oct. 1963.

Experimental observations of reflection and transmission of a cw wave propagating in the quasi Te_{11} mode in a cylindrical wave guide filled with a time decaying plasma are presented. The discharge column occupies, with the exception of a thin layer of quartz, the entire cross section of the wave guide. The length of the plasma column is large compared to the empty guide wavelength. The transmitted wave displays a series of broad maxima and sharp minima whose relative amplitudes increase with time. Reflection maxima, coinciding in time with transmission minima, are also found to exist. However, close quantitative examination reveals that the strong absorption associated with the transmission minima increases with decreasing electron density. With regard to phase separation, frequency and pressure variation the extrema seem to fit a simple theoretical model, which, however, fails to explain the absorption mechanism, the latter being also associated with a reversed cross-modulation not explainable by the Ramsauer effect. Experimental findings exclude any explanation based on non-linear effects. (auth)

11356 DEVICE FOR THE GENERATION OF ARC MOVEMENT IN A TRANSVERSE MAGNETIC FIELD. Erwin Marx and Juergen Salge. German Patent 1,160,117. Dec. 27, 1963. Filed May 26, 1962.

The device described is a rail-type plasma accelerator comprising two main electrodes (rails) and at least one additional electrode between the two main electrodes whose purpose is to initiate the arc, which is connected with one of the two main electrodes via a resistance. (Gmelin Inst.)

11357 PYROTRON PROCESS AND APPARATUS UTILIZING ENHANCEMENT PRINCIPLE. Richard F. Post (to U. S. Atomic Energy Commission). U. S. Patent 3,120,476. Feb. 4, 1964.

Processes and apparatus for producing high-temperature gases or plasmas are described. A magnetic confinement field having a linear central region and end regions of increased magnetic field intensity is used. A radiofrequency electric field is applied transversely across the magnetic field to increase the angular velocity of the particles introduced therein and to orient the resultant velocity vectors of the particles to directions outside the loss angle cone of the gradientially intensified reflector field regions. The application of such radiofrequency fields may be used, for example, to trap particles injected into the zone and to heat the injected particles to reaction temperature. In a second embodiment of the device two adjacent zones are established between a succession of three intensified field regions. A radiofrequency field is applied across the first of the zones and particles are introduced and trapped therein and are heated to an appropriate temperature. Thereafter the intensified field region between the zones is reduced whereby the plasma formed in the first of the zones enters the second zone and is contained therein. (AEC)

11358 METHOD FOR CONFINING A DENSE PLASMA. Albert J. Hatch (to U. S. Atomic Energy Commission). U. S. Patent 3,120,477. Feb. 4, 1964.

A method of containing and compressing plasma discharges, which may produce thermonuclear-derived neutrons and ultimately useful power, is described. An r-f cavity is evacuated and a low-Z gas is introduced at a low pressure. Stationary electromagnetic waves are excited within the cavity in the TE_{210} quadrupole mode, the excited electromagnetic waves ionizing the low-Z gas and confining and compressing the plasma therefrom at the center of the cavity. (AEC)

11359 MEANS FOR PRODUCING HIGH DENSITY PLASMAS. Richard F. Post (to U. S. Atomic Energy Commission). U. S. Patent 3,120,481. Feb. 4, 1964.

A device for producing high-density, high-temperature compressed plasmas is described. A device capable of producing a pinched-type discharge, i.e., a high-intensity electrical discharge through a tenuous plasma of selected composition, is provided. As employed for example in a linear pinch device, a central electrode, which is disposed within the plasma column, is energized to produce a secondary magnetic field that operates internally to stabilize the plasma column against so-called kink instabilities. The attainable lifetime for maintaining a stable high-density, high-temperature plasma is increased. (AEC)

Shielding

11360 (CEA-2288) BLINDAGES DE PROTECTION POUR LES ELEMENTS COMBUSTIBLES IRRADIES—

EVALUATION RAPIDE. (Protective Shields for Irradiated Fuel Elements—A Rapid Evaluation). J. Guirlet, C. Jain, J. M. Lavie, and G. Lucas (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 97p.

The calculation of the protection required for the handling of irradiated fuels necessitates a knowledge of the γ spectrum as a function of the burnup, of the activation time, and of the "cooling" time, all of which involves lengthy and difficult calculations. With a view to simplifying them, diagrams are established, using literature data, which make it possible to find rapid solutions to the various problems which can arise. The γ activity of the various fission products was classified into seven groups corresponding to the intervals in which their γ energy falls. Curves were drawn up in function of the time of irradiation and of the "cooling" time. They give, for each of the seven groups, the γ activity in Mev/sec for a power of 1 w. From these curves, diagrams were built up making it possible to solve protection problems for the following materials: lead, iron, ordinary concrete (d = 2.3); barium oxide concrete (d = 3.4); and heavy concrete (d = 4.4). These diagrams give the intensity of irradiation I in r/hr: at a distance of d cms from the source; for any value of the energy (w watts) produced in the U^{235}; for irradiation times of 30, 100, 200, and 500 days; and for "cooling" times of 1, 10, 30, 90, 180, and 365 days as a function of the thickness of the protective material used. It is believed that these diagrams can be of great use to those in charge of study projects concerning charging and uncharging machines in power reactors, as well as irradiated fuel treatment plants. The accuracy is of the order of 30% for the dose received behind the protective screen. (auth)

11361 ECONOMY OF EXPERIMENT IN DOSE ALBEDO. N. F. Shoemaker and C. M. Huddleston (Naval Civil Engineering Lab., Port Hueneme, Calif.). Nucl. Sci. Eng., 18: 113-15(Jan. 1964).

Treatments of the differential dose albedo of gamma rays on concrete have supposed that the albedo value is a function of the energy of the incident gamma radiation, the polar angle of incidence, the polar angle of reflection, and the azimuthal angle of reflection. It is demonstrated here that, if certain assumptions are made regarding the mechanism of reflection, it is not necessary to investigate variations in albedo with azimuthal angle of reflection. Once differential dose albedo is determined for a complete set of incident and reflected polar angles with zero azimuth, albedo at any azimuth can be derived by a suitable transformation. (auth)

11362 SHIELDING ISOTOPIC POWER SOURCES FOR SPACE MISSIONS. J. P. Nichols and E. D. Arnold (Oak Ridge National Lab., Tenn.). Nucleonics, 22: No. 2, 52-6 (Feb. 1964).

Separation distance, rather than shielding, is suggested for protection of payloads from the isotopic power sources for 5-yr missions. Radiation-level calculations are presented for unshielded sources using Cs^{137}, Sr^{90}, Pu^{238}, Cm^{244}, Pm^{147}, Ce^{144}, Cm^{242}, and Po^{210}. (R.E.U.)

11363 ARGON IMPROVES $ZnBr_2$ SHIELDING WINDOWS. William B. Lane and Melvin J. Nuckolls (Naval Radiological Defense Lab., San Francisco). Nucleonics, 22: No. 2, 88-9(Feb. 1964).

The use of an argon atmosphere and mild steel container for $ZnBr_2$ shielding windows for hot cells is reported. This combination is free of the objectionable changes caused by oxidation and gamma radiation that appear in air-painted surface containers. (R.E.U.)

11364 LABYRINTH PLANNING METHOD FOR A PASSAGE OF A HOT CELL. PART 2. EXPERIMENTAL STUDY OF POCKET EFFECTS OF LABYRINTH FOR PROTECTION OF GAMMA-RAYS. Masahisa Sakuda. Trans. Architect. Inst. Japan, 88: 22-6(Aug. 1963). (In Japanese)

A $\frac{1}{2}$-scale model labyrinth for use as an entrance to a γ hot cell facility was made with ordinary concrete blocks, and dose rates were measured using a Co^{60} point source and pocket chambers. The measured dose rates were compared with calculated estimates. The results quantitatively confirmed the pocket corner effects of the labyrinth. The estimating method will be applied practically. (TCO)

11365 CARRIER STEM FOR A RADIOACTIVE POINT SOURCE. Wilhelm von Heesen (to Gelsenberg Benzin AG). German Patent 1,153,464. Aug. 29, 1963. Filed Feb. 6, 1959.

A container for radioactive material is described that comprises a hollow body, containing: a block of material that is substantially impervious to radiation from radioactive material; a hole half-way through the block, adapted to be closed by the carrier stem inserted in said hole and having at its forward end means for housing the radioactive material (the stem being substantially impervious to radiation directed along its length); and means on the stem for engagement by a member by which the position of the stem in the hole can be adjusted. A detailed description of the carrier stem, e.g., the means for housing the radioactive material, is given. (Gmelin Inst.)

REACTOR TECHNOLOGY

General

Refer also to abstract 9961.

11366 (BNL-7650) ORGANIC REACTOR COOLANT STUDIES. H. Susskind, J. Weiss, W. Becker, M. Beller, and C. H. Collins (Brookhaven National Lab., Upton, N. Y.). June 30, 1963. Contract AT-30-2-GEN-16. 182p.

An experimental program was carried out to study (1) the mechanisms of fouling film formation in terphenyl coolants, (2) the corrosion of metals by the coolant, and (3) the pyrolytic and radiolytic stability of condensed ring polyaromatic compounds. This work was done in support of the Organic Cooled Reactor program and was terminated prior to its completion. No fouling film deposits, or only barely detectable traces of α Fe, were found by x-ray diffraction measurements of type 304 SS heater test specimens exposed to the individual terphenyl isomers and to a variety of impurities over a surface and bulk coolant temperature range of 260 to 425°C in out-of-pile static capsule fouling tests. Iron and water solubility studies were conducted in pure p- and pure o-terphenyl, and in coolant exposed to Ar cover gas containing up to 6.5 vol % H_2O or 1 vol % O_2. No Fe was found in the coolant. Evidence was found, however, that constituents present in certain decomposition products tend to promote Fe transfer to the coolant. No H_2O was found in p-terphenyl, while, on the other hand, it was found to be slightly soluble in o-terphenyl. Five materials—type 304 SS, ASTM-A 285 Grade C mild steel, type 1100 Al, Al-288, and SAP-M 257—were screened for their resistance to corrosion and mass transfer in a tilting-furnace apparatus. No evidence of corrosion or mass transfer was found in tests with p-terphenyl (425–260°C) and o-terphenyl (375–260°C). The radiolysis of several polyaromatic compounds which might be used as coolant materials in a reactor was investigated using both gamma and reactor radiation. The compounds selected were naphthalene, anthracene, naphthacene, pyrene, phenanthrene, 1-2-benzanthracene, chrysene, triphenylene, 9,10-dihydrophenanthrene, phenazine, 7,8-benzoquinoline, and m-phenanthroline, in addition to the uncondensed ring compounds, biphenyl, o-, m-, and p-terphenyl, and bibenzyl. Gas yields, percentage decomposition, percentage "high boiler," and number average molecular weights were determined. A correlation was found between radiation stability and electron affinity as well as singlet-triplet excitation energies. The most stable compounds were the condensed-ring compounds, naphthalene, pyrene, chrysene, phenanthrene, and triphenylene. (auth)

11367 (TID-7672(p.259-74)) IMPROVING AGREEMENT OF THEORY WITH BEHAVIOR IN PHYSICALLY COMPLEX REACTOR SYSTEMS. A Panel Discussion. J. Chernick (Brookhaven National Lab., Upton, N. Y.); M. C. Edlund (Babcock and Wilcox Co., [Lynchburg, Va.]; P. F. Gast (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.); H. W. Graves, Jr. (Westinghouse Electric Corp. Atomic Power Div., [Pittsburgh]; A. F. Henry (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh); R. J. McWhorter (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.); and T. M. Snyder (General Electric Co. Atomic Power Equipment Dept., [San Jose, Calif.]).

Ways of improving agreement of theory with behavior in physically complex reactor systems are discussed. The problem of predicting reactivity lifetimes of relatively high burnup cores (20,000 Mwd/ton) in large water-moderated power reactors is considered. Selection of behavior to study that has the greatest effect on economic nuclear power is discussed. Methods of calculating reactor parameters and predicting their nuclear properties are treated. Developing improved computer methods for these calculations is also discussed. (M.C.G.)

11368 (WCAP-3720) REACTIVITY DEPENDENCE UPON MODERATOR TEMPERATURE AND BORON CONCENTRATION IN LARGE PWR CORES CONTROLLED BY CHEMICAL SHIM. P. G. Lacey (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Nov. 1962. Contract AT(30-1)-3064. 71p.

Results are presented of an analytic study in which moderator temperature coefficients of reactivity and incremental boron worths were determined for large pressurized-water reactors controlled by chemical shim (solution of boric acid in the moderator). Data are presented for low-enriched, light-water-moderated cores (containing close-packed UO_2 fuel rods clad with stainless steel) over a wide range of temperatures and boron concentrations. The data apply to zero power conditions where the fuel and clad temperature is assumed to be that of the moderator. (auth)

11369 (WCAP-3735) COOLANT MIXING IN OPEN LATTICE REACTOR CORES. R. A. Dean (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Aug. 1963. Contract AT(30-1)-3064. 50p.

An experimental program was conducted to determine the overall mixing coefficient in fuel assemblies designed for pressurized-water reactors. This program also determined the effects of mixing in a fuel assembly and between adjacent assemblies in an open lattice core. These tests were conducted in a low-pressure water loop at Reynolds numbers ranging from 15,000 to 46,000. Electric heaters, fabricated to the dimensions of the fuel rods, were located in one assembly and the mixing coefficients were evaluated from the temperature distribution in this assembly at various flow rates. The coolant mixing induced by the spring-finger grids resulted in mixing coefficients that were much larger than the coefficients obtained for bare fuel rods. The mixing between assemblies substantially reduced the enthalpy rise in the flow channels along the edge of the assembly and caused the hot channel to be shifted inward toward the center of the assembly. (auth)

11370 (AEC-tr-6324) SOME RESULTS OF THE STUDY OF THE SECURITY ENVELOPES OF THE RAPSODIE REACTOR. G. Drevon and M. Falgayrettes. Translation of a paper presented at the 8th Nuclear Congress Symposium on Fast Reactors, Rome, June 17-19, 1963. 25p.

Experiments using scale models were conducted on the performance of the security envelopes of Rapsodie in the case of the maximum possible accident. The interpretation of the results and their extension to sodium-cooled fast reactors of industrial size are considered. (D.L.C.)

11371 REACTOR SAFETY: ENGINEERING EXTRA MARGINS. Atomics, 17: 31; 33-4; 36(Jan.-Feb., 1964).

Changes in reactor safety evaluation methods are discussed with respect to attempts to obtain safer operation

with less cost. The power excursion and loss-of-coolant problems are discussed. (R.E.U.)

11372 CHEMICAL ASPECTS OF NUCLEAR REACTORS. VOLUME I. GAS-COOLED REACTORS. J. K. Dawson and R. G. Sowden. London and Washington, D. C., Butterworths, Inc., 1963. 281p. $11.00.

A review is presented of gas-cooled reactor programs in Europe and in the U.S.A. The factors affecting the choice of coolant are discussed. The production and physical and chemical properties of graphite, for reactor use, are reviewed. Metal oxidation under reactor conditions is discussed with emphasis on uranium, magnesium, beryllium, and steels. Ceramic fuels, their preparation, properties, and irradiation behavior, are discussed. Ceramics of uranium, plutonium, and thorium and their mixtures are considered. The migration of fission products in metallic and ceramic fuels is discussed. Numerous references are given. (R.E.U.)

11373 CHEMICAL ASPECTS OF NUCLEAR REACTORS. VOLUME II. WATER-COOLED REACTORS. J. K. Dawson and R. G. Sowden. London and Washington, D. C., Butterworths, Inc., 1963. 402p. $15.00.

A review is presented of water-cooled and -moderated reactors in operation. The radiation chemistry of water is discussed. Solution studies for homogeneous aqueous reactors are presented; slurry aspects are also considered. The corrosion of aluminum, magnesium, zirconium, fissile alloys, and steel in water-cooled reactors is discussed. Safety aspects are discussed, considering high-temperature metal-water reactions, fission product behavior, and soluble poison control of reactors. Numerous references are given. (R.E.U.)

11374 CHEMICAL ASPECTS OF NUCLEAR REACTORS. VOLUME III. MISCELLANEOUS TOPICS. J. K. Dawson and R. G. Sowden. London and Washington, D. C., Butterworths, Inc., 1963. 212p. $10.00.

The properties of liquid metals as reactor coolants are discussed with emphasis on Na, NaK, Li, Hg, and liquid metal fuels for homogeneous reactors. Organic liquids and molten hydroxides and fluorides are discussed as reactor coolants. The properties of UF_6, NpF_6, and PuF_6 as gaseous fuels are discussed. Neutron shielding materials and requirements and the production of chemicals using reactors are also discussed. Numerous references are given. (R.E.U.)

11375 NUCLEAR REACTOR THEORY. Giovanni Lanza (Northeastern Univ., Boston). Book V of "Nuclear Engineering Fundamentals." New York, McGraw-Hill Book Company, 1964. 180p.

The basic concepts of reactor theory are given. Neutron physics, collision theory, slowing-down theory, and diffusion theory are discussed. Reactor design, control, safety, and shielding are considered. A brief description of reactor types is presented. Sanitary engineering aspects of radioactivity, reactors in aviation, and radiosterilization of foods are also discussed. (C.E.S.)

11376 NUCLEAR REACTOR RESEARCH AND DEVELOPMENT. p.289-362 of "Fundamental Nuclear Energy Research." Washington, D. C., GPO, 1963.

Research and developments in reactor physics, fuel reprocessing, reactor safety, reactor fuels and materials, and reactor components are summarized. (D.C.W.)

11377 MEASUREMENT OF THE SPATIALLY DEPENDENT TRANSFER FUNCTION OF NUCLEAR SYSTEMS BY NOISE ANALYSIS. Chester D. Klystra and Robert E. Uhrig (Univ. of Florida, Gainesville). 21p. (CONF-332-6)

From Symposium on Noise Analysis in Nuclear Systems, Gainesville, Fla., Nov. 1963.

The methods and apparatus used for measurements and data reduction are described. A comparison of some experimental results with a theoretical spatially dependent transfer function obtained from the Fermi age and diffusion theories is presented. (R.E.U.)

11378 EFFECT OF PARAMETER VARIATION IN DOPPLER EFFECT CALCULATIONS. H. H. Hummel and A. L. Rago. 28p. (CONF-334-8)

From Conference on Breeding Economics, and Safety in Large Fast Power Reactors, Argonne, Ill., Oct. 1963.

A series of calculations was carried out, in which arbitrary variations of parameters were made, to better understand the uncertainty in Doppler effect calculations because of uncertainty in nuclear data. Resonance integral calculations were done in the narrow resonance approximation. No account was taken of multilevel effects in fissile material or of interference effects between U^{238} and Pu^{239} resonances. Distribution functions for neutron and fission widths were taken into account. The calculations were performed for a fundamental mode flux using the ELMOE program. (R.E.U.)

Auxiliaries and Components

11379 (ANL-6695) TIME-OPTIMUM CONTROL OF NUCLEAR REACTORS WITH VELOCITY-LIMITED CONTROL DEVICES. Thomas P. Mulcahey (Argonne National Lab., Ill.). Oct. 1963. Contract W-31-109-eng-38. 125p.

An attempt was made to devise a time-optimum automatic controller for reactors. Analytic, analog, and digital solutions to the one- and six-group kinetics equations were obtained to determine which basis (power level or time) formed the best switching criteria and to establish switch time-power level change and switching power level-power level change relations. A model based on the EBR-II power system was used, and ramp input of reactivity and a logarithm of the power level feedback were assumed in the solutions. The analytic solution also considered other possibilities. It was concluded that a power-level-based controller should be adopted. Other conclusions, results, and the proposed controller design are given. (D.C.W.)

11380 (DEG-Inf-Ser-266) READING LIST ON REACTOR CONTROL AND INSTRUMENTATION: UNCLASSIFIED U.K.A.E.A. WORK 1952-1960. U. Chadwick (United Kingdom Atomic Energy Authority. Development and Engineering Group, Risley, Lancs, England). 1960. 9p.

A selection of 65 references is presented. The references are grouped into books and conference papers, reports, and journal references. (D.L.C.)

11381 (IDO-10039) UNIVERSAL INSTRUMENTATION AND CONTROL SYSTEM. Feasibility Report. (Montek. Div. of Memcor, Salt Lake City). Dec. 31, 1963. Contract AT(10-1)-1163. 164p.

A study was conducted to determine the technical and economic feasibility of designing and developing a universal instrumentation and control system for Army nuclear power plants. Existing plant instrumentation is evaluated, and the necessary application of advanced technology is considered. A program outline is presented for the design and development of a universal instrumentation and control system and for the fabrication and testing of a prototype. Finally, economic and practicability considerations are given. (D.L.C.)

11382 (IDO-16907) LOW-COST ORGANIC MODERATOR-COOLANTS FOR NUCLEAR REACTORS. L. E. Gardner, W. M. Hutchinson, and J. C. Hillyer (Phillips Petroleum Co. Research and Development Dept., Bartlesville, Okla). Dec. 23, 1963. Contract AT(10-1)-1080. 30p.

Two sources of promising low-cost coolants for nuclear power reactors were found: heavy cycle oils from catalytic cracking of heavier petroleum fractions, and coal tar oil. The former required hydrodesulfurization and hydrodealkylation for satisfactory radiolytic and thermal stability. The latter was already very lightly alkylated and radiolytically stable but required hydrodesulfurization for satisfactory thermal stability. The present commercial worth of the raw stocks is about one cent a pound. Refining should not raise their cost above five cents a pound if done on a commercial scale. This compares well with the present price of terphenyl (17¢/lb). The refined coolants resembled terphenyl in boiling range, density, viscosity, and proton density. They generated from 0.5 to 0.8 the polymer generated by terphenyl in simultaneous irradiations at 650°F under 6-Mev electrons for eight hours or a total dose of about 6×10^9 rads. The refined coolants generated from $1\frac{1}{2}$ to 30 times as much gas (mainly hydrogen) as generated by terphenyl. Even at the highest rate the loss of coolant was negligible. The refined coolants begin to decompose thermally at 750°F, about 50°F lower than terphenyl. The new coolants have been tested only in static systems but promise sufficient reduction in coolant costs that they should be tested in in-pile loops when needed. The source of the stocks from which the coolants were made appeared to have little effect on their stability. The degree of alkylation of the condensed aromatic rings is limited by their stability. The more stable coolants contained on an average from 0.3 to 0.5 methyl group per molecule and from 0.04 to 0.3 higher alkyl group averaging two carbons in length per molecule. Phenanthrene appeared to be the dominant ring system with some anthracenes indicated in the coolant from coal tar and some pyrene in the petroleum-based coolant. (auth)

11383 (NAA-SR-9163) INPILE EXPERIMENTS ON RETENTION OF FISSION PRODUCTS IN 500°F SODIUM. W. P. Kunkel, D. M. Elliott, and A. S. Gibson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 30, 1964. Contract AT-11-1-GEN-8. 61p.

The results of three separate inpile capsule experiments are presented. The first experiment, IP-1, demonstrated the feasibility of using the KEWB transient reactor facility as a means of melting U in a Na environment and thus injecting fission products into the Na. The melted fuel is estimated to have reached a maximum temperature of between 1470 and 3900°C. The recovered fuel particles averaged in size from 75 to 125 microns. In the second experiment, IP-0, terphenyl was substituted for Na and permitted a comparison of the relative effectiveness of the two coolants in retaining fission products. The very high thermal conductivity of Na may have accounted for a lower release of fission products from both the melting fuel and from the coolant than in the case of the organic. With a prenuclear transient inventory of 5.2 mc of I^{131}, a 4-mil thick, 93%-enriched U fuel disc weighing 0.438 gm, and immersed in 235 gm of 500°F Na was subjected to a 1-msec period nuclear transient, IP-2. The energy release in the fuel disc was approximately 0.66 Btu, which resulted from the 2.2×10^{13} fissions occurring in the disc during the burst. Zr, Nb^{95}, Ru^{103}, I^{131}, Cs^{137}, Ba, and La^{140} were quantitatively identified in the Na. Xe^{133}, Ba, and La^{140} were quantitatively identified in charcoal traps located downstream from the capsule in a flowing helium gas stream. Approximately 1 to 10% of the preburst I inventory was released to the Na, and less than 0.002% of the I in the Na was released to the gas traps. (auth)

11384 (NYO-10492) SHUTDOWN REACTIVITY METER DEVELOPMENT. PHASE I. FEASIBILITY. S. J. Garrett, M. A. Schultz, and C. M. Yang (Milletron, Inc., Irwin, Penna.). Sept. 1963. Contract AT(30-1)-3122. 61p.

When a neutron detector is placed in or near the core of a nuclear reactor, a d-c electrical signal which is proportional to the neutron flux is obtained. Superimposed on the d-c signal is a random signal. The power density spectrum of the random noise from the reactor contains information about the reactor both at critical and when the reactor is shutdown. At shutdown the ratio of the power density spectrum evaluated at a low frequency (below β/l sec^{-1}) to the power density spectrum evaluated at a high frequency (above $1\text{-}k/l$ sec^{-1}) is proportional to Δk. In this report, the feasibility of a two-frequency shutdown reactivity meter based on this principle is examined. Experiments were conducted to determine the feasibility of a shutdown reactivity meter on a cold, clean reactor. In these experiments which were conducted using the Westinghouse CES reactor at Waltz Mill, it was found that the shutdown reactivity could be measured down to −8% under the ideal condition of the neutron detector in the center of the core. The effects of locating the neutron detector in various core positions and of rod configurations on the accuracy are also reported. The lower limit at which reactivity measurements could be made appeared to be limited by bombardment noise due to the random arrivals of uncorrelated neutrons at the detector. The conclusions that may be drawn from these experiments are: (1) Shutdown reactivity can be measured for a cold, clean reactor by the two-frequency method. (2) The rod configuration has little effect on the measured reactivity when the reactor is almost critical. (3) The location of the neutron detector determines the amount of shutdown reactivity that can be measured. The maximum range of measured shutdown reactivity occurs when the neutron detector is in the center of the core and decreases as the detector is moved away from the center. (auth)

11385 (RT/EL(63)-5) CIRCUITI ELETTRONICI PER LA REGOLAZIONE AUTOMATICA DEL REATTORE PRO. (Electronic Circuits for the Automatic Control of PRO Reactor). M. Conti and A. Garroni (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). May 1963. 23p.

A modular analogic control system for nuclear plants is described. This system has been employed in the control system of PRO reactor. (auth)

11386 (WCAP-3719) CONTROL ROD PROGRAMMING IN A LARGE MULTIREGION CORE. D. L. Miller (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Oct. 1962. Contract AT(30-1)-3064. 61p.

A program was determined for the withdrawal of control rods from a large, multiregion loaded core of a pressurized-water reactor. Various orders of rod withdrawal were investigated, and the two-dimensional power distributions are compared to obtain the best ratio of peak-to-average power. (D.L.C.)

11387 (WCAP-3731) RADIOTRACER STUDIES OF HIDEOUT AT HIGH TEMPERATURE AND PRESSURE. L. F. Picone, D. D. Whyte, and G. R. Taylor (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). June 1963. Contract AT(30-1)-3064. 76p.

Local concentration or hideout of solutes at clean and fouled heat-transfer surfaces was studied by means of a radiotracer hideout test facility. The study was directed at the elucidation of the factors affecting hideout from boric acid solutions on surfaces fouled with transport corrosion products of stainless steel (called crud), for application to the problem of boron hideout in closed-cycle water reactors with chemical control by boric acid shim. (auth)

11388 NEW NONBOLTED CLOSURE FOR REACTOR VESSELS. Norman R. Johanson (Babcock and Wilcox Research Center, Alliance, Ohio). Nucleonics, 22: No. 2, 79-80; 82; 84(Feb. 1964).

A closure technique for pressure vessels capable of withstanding high pressures and temperatures is described. The new design features a seal backup ring with no bolts attached. Mechanical and thermal stress analyses were performed. (R.E.U.)

11389 PRO PROGRAM. DRIVE OF THE CONTROL RODS. Salvatore Russo. Riv. Ing. Nucl., 1: 184-7(July-Aug. 1963). (In Italian)

The PRO reactor, cooled and moderated with organic liquids, is being developed at CNEN. A drive mechanism for the 21 control rods is being developed. It is a magnetic jack in which the raising and lowering is done by a succession of magnetic fields parallel and perpendicular to the rod motion, alternating according to a prefixed sequence. The principles to be followed in the design and development are summarized, and the characteristics of the motor are given. (J.S.R.)

11390 NUCLEAR MATERIALS. Alvin Boltax (Westinghouse Electric Corp., Pittsburgh). Book IV of "Nuclear Engineering Fundamentals." New York, McGraw-Hill Book Company, 1964. 186p.

The basic metallurgical problems faced in choosing materials for reactors are discussed. The physical, chemical, and metallurgical properties of metal are described. A survey of the broad field of metallurgy, starting with ore processing and ending with fabrication techniques, is given. Reactor materials problems such as radiation damage, corrosion, and thermal problems are outlined. Reactor fuels, constructional materials, reflectors, and moderators are also discussed. (C.E.S.)

11391 SAFETY DEVICE FOR NUCLEAR REACTORS. Arno Mueller (to Deutsche Babcock and Wilcox-Dampfkesselwerke AG). German Patent 1,156,905. Nov. 7, 1963. Filed Aug. 25, 1959.

The safety device described comprises a pressurized container filled with mercury (outside the reactor core), and means for injecting the mercury (in case of emergency) into separate chambers disposed within the reactor core. In order to prevent the injected mercury from leaving the core, the absorbing chambers are partially filled with a metal that reacts with the injected mercury to form an amalgam. (Gmelin Inst.)

11392 CONTROL ROD FOR A NUCLEAR REACTOR. Eric Ledin (to U. S. Atomic Energy Commission). U. S. Patent 3,120,480. Feb. 4, 1964.

A control rod structure for use in gas-cooled reactors is described. The control rod is fabricated with an elongated support rod upon which are disposed spacer elements at separated intervals. Generally annular sections of neutron-absorbing material are disposed between adjoining pairs of spacer elements. Compressible disk-washers are disposed intermediate to each spacer element and the adjoining end of a section of neutron-absorbing material in an appropriate position to cushion the section of neutron-absorbing material against shock and thermal load stresses. A means for connecting the control rod to a driving means, for example a hydraulic motor, and for lifting and detaching the control rod sections therefrom, is provided. (AEC)

11393 CONTROL ROD FOR NUCLEAR REACTOR. Arthur M. Harris and Eric Ledin (to U. S. Atomic Energy Commission). U. S. Patent 3,121,045. Feb. 11, 1964.

A control rod system particularly adapted for use with a gas-cooled reactor is described. The control rod includes an alignable guide tube in which is disposed articulated poison rod sections actuated by a push rod entering from below. Drive means for the push rod includes a rotatable drive shaft driven by a reversible fluid drive motor through a screw drive mechanism. A first fluid pressure source drives the fluid motor selectively in either direction at a first predetermined speed for ordinary control purposes. A second higher pressure source likewise drives the fluid motor at a greater speed as required to scram the control rod into fully inserted position in emergency situations. (AEC)

11394 PRESSURE VESSELS. Kenneth A. Trickett and James T. Rogers, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,121,046. Feb. 11, 1964.

An internally insulated and externally cooled pressure vessel for containing and supporting core assembly components of a gas-cooled nuclear reactor is described. A thermal barrier is supported by an especially adapted cone-shaped member within the upper end of the vessel. A thermal shield is disposed between the thermal barrier and external vessel and is supported by lower portions of the barrier in such a manner as to provide a barrier to heat conduction. With such construction, passage-ways are provided from a conduit means disposed at upper portions and leading to a point of introduction of the coolant into the reactor core near the lower end of the vessel. Low heat loss from a reactor core disposed within the shroud is afforded. (AEC)

11395 REACTOR HAVING FUEL ELEMENT COATED WITH BURNABLE POISON. Haig P. Iskenderian (to U. S. Atomic Energy Commission). U. S. Patent 3,122,484. Feb. 25, 1964.

A thermal nuclear reactor containing a plurality of fuel elements, each of which consists of a single plate of a fuel material such as natural uranium, wherein some of the fuel elements have a layer of a material such as cadmium completely surrounding the element, is described. This layer is initially of sufficient thickness to prevent thermal neutrons from passing through and of such thickness as to burn out when the reactivity of the fuel plates, which are not surrounded by the poison layer, is no longer sufficient to support a chain reaction by themselves. (AEC)

Crititicality Studies

11396 (ACNP-64003) SHAPED BURNABLE POISON DEVELOPMENT PROGRAM UNDER THE EURATOM PROGRAM. Quarterly Progress Report, October 1, 1963–December 31, 1963. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Jan. 17, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1229. 60p. (EURAEC-968)

The analytical model for interpretation of the danger coefficient measurements was developed based on two-

group diffusion theory. Transport theory corrections are made in the thermal group to more accurately describe absorptions in poison lumps. Capsules of homogeneous Gd_2O_3 were irradiated to 1.0×10^{20} nvt. Preliminary analysis indicates good agreement between measured and calculated depletion behavior and a low poison residual. Capsules containing both homogeneous and lumped poisons were fabricated to tight specifications for the physics tests. Studies were conducted of the reaction between UO_2 and a number of metal oxides mixed with Gd_2O_3. Reactions of other undesirable effects were found for mixtures of TiO_2, Al_2O_3, and Co_2O_3 with Gd_2O_3 at temperatures less than 3180°F. Mixtures of ZrO_2 and Cr_2O_3 with Gd_2O_3 appeared promising. The ZrO_2 mixtures were investigated over a wide range of mole ratios of ZrO_2 to Gd_2O_3. The ZrO_2 investigations will continue at temperatures higher than 3180°F. To simulate fuel rods with poison lumps selectively located in a low temperature region of the rod, extrusions were made of annular poison containing regions surrounding poison-free rods. (N.W.R.)

11397 (HW-79054(p.43-6)) SUBCRITICAL MEASUREMENTS WITH 2.0 WT% Pu–Al RODS IN LIGHT WATER. W. P. Stinson, J. A. Marks, and L. C. Schmid (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Experiments were conducted with 2.0 wt % Pu–Al rods in light water using critical approaches and exponential measurements. The critical Pu masses, critical rod numbers, critical bucklings, and extrapolation lengths obtained are given. The critical mass and buckling are plotted as functions of the H : Pu ratio. (D.C.W.)

11398 (HW-79054(p.54-63)) CRITICAL EXPERIMENTS WITH PuO_2–POLYSTYRENE COMPACTS. C. R. Richey, J. D. White, E. D. Clayton, S. R. Bierman, K. L. Garlid, and D. R. Skeen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The critical dimensions and Pu masses for arrays of PuO_2–polystyrene cubes with a Pu concentration of 1.14 g/cm^3 and a H/Pu atomic ratio of 15 were determined using an approach to criticality technique with a split table. Lucite reflectors were used in most measurements. Temperatures in the core regions were also measured, and neutron lifetimes in the arrays were obtained by noise analysis and pulsed neutron experiments. Additionally, temperature coefficients were measured, and flux traverses were carried out. (D.C.W.)

11399 (TID-7672(p.347-66)) REACTOR CALCULATION MODELS FOR BURN-UP STUDIES. D. Hicks (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England).

The basis of thermal-reactor-calculation models at present in use in the United Kingdom and the comparison between their predictions and available experimental data are reviewed. The methods described are based on fundamental nuclear data and the logical description of the neutron processes with suitable approximations. In different reactor types the various components of the reactor-physics processes assume differing degrees of relative importance, and various geometrical approximations appear appropriate. This led to the development of two calculation systems, one appropriate to gas-cooled and the other to water-cooled reactors. The gas-cooled-reactor calculation scheme involves the determination of the fast-neutron parameters by the Monte Carlo method and a solution of the multi-group thermalization problem by a combination of diffusion theory in the moderator and collision theory in the fuel. These thermalization calculations are repeated at intervals during burnup, with the buildup of fission products represented by pseudo-elements. Predictions of the model are compared with data from experimental assemblies and the observed burnup behavior of the Calder reactors. A method applicable to most types of water reactor was constructed and coded in the Methuselah program. The concepts involved form an extension of the few-group design models developed by the Bettis Laboratory. Methuselah produces few-group lattice-cell parameters as a function of burnup using fairly detailed representations of the cell geometry. Overall reactor behavior is then synthesized by space-diffusion codes. Particular attention was given to the steam-generating heavy-water reactor. (A prototype 100-Mw(e) unit of this type, fueled with low-enrichment uranium oxide, cooled by boiling light water, and moderated by heavy water is under construction at Winfrith Heath.) A comparison is presented showing how the water-reactor nuclear-design model was checked against experimental assembly data and burnup results from other water reactors. (auth)

11400 (WCAP-3723) FINE STRUCTURE POWER PEAKING IN A CRITICAL EXPERIMENT MOCKUP OF A CHEMICAL SHIM CORE. P. G. Lacey (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Mar. 1963. Contract AT(30-1)-3064. 84p.

The analytic and experimental results obtained in an investigation of the effects of core heterogeneities and chemical shim control upon local power distributions in the mockup of a typical assembly of a large light water moderated pressurized water reactor are summarized. Analytically determined power peaking in the steel clad UO_2 fuel rods adjacent to water gaps is compared with the results obtained by gamma scanning fuel rods in a parallel program of critical experiments. Data were obtained for both uniform and non-uniform enrichments at a high concentration of boric acid in the moderator, as well as with none present. The analytically determined effect of elevated temperature upon water gap power peaking is shown, although no experimental data were taken other than at room temperature. (auth)

11401 (WCAP-3729) THE IN-PILE TEST OF CHEMICAL SHIM. L. F. Picone (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). June 1963. Contract AT(30-1)-3064. 87p.

A series of in-pile loop tests was performed to determine, in part, the acceptability of chemical shim operation at high temperature and high pressure for a large plant core design. Boron as boric acid was the neutron poison studied. No unacceptably adverse behavior attributable to boric acid was observed. Data is presented on corrosion product composition, release, transport and deposition, and boron adsorption on corrosion products in a borated system. Data on the decontamination of the loop at the completion of the irradiation tests series is also presented. (auth)

11402 AXIAL FLUX SHAPE UNDER A CONTINUOUS FUEL CYCLE AT EQUILIBRIUM. G. Ghilardotti and F. Vicentini Orgnani (AGIP Nucleare, San Donato Milanese, Milan). Energie Nucl. (Milan), 10: 671-8(Dec. 1963).

The one-group equation was solved for a reactor operating under a continuous fuel cycle at equilibrium. The critical height of the reactor and the axial flux shape could thus be found as a function of the maximum discharge irradiation. The results are discussed and compared with those obtained by first order perturbation theory. The eigen-

values found by the two approaches did not differ appreciably; on the contrary, the axial flux shape, as calculated by the "exact" method, was found to be appreciably more flattened than predicted by perturbation theory. (auth)

11403 LATTICE-PARAMETER MEASUREMENTS FOR SOLID AND CONCENTRIC TUBES OF URANIUM FUEL IN GRAPHITE LATTICES. D. E. Wood, K. R. Birney, and E. Z. Block (General Electric Co., Richland, Wash.). Nucl. Sci. Eng., 18: 116-25(Jan. 1964). (HW-SA-3013)

Lattice parameters were measured for natural uranium concentric tubes and solid fuel elements of 2.5 inches outside diameter in the Physical Constants Testing Reactor (PCTR). The primary quantities measured are the mass of copper required to reduce k_∞ to one, copper activations throughout the lattice, and cadmium ratios for U^{238} capture, U^{235} and U^{238} fission, copper, gold, and lutetium. The results derived from these measurements are k_∞, f, p, ϵ, and the effective neutron temperature for the concentric tube in a 10.5-inch graphite lattice with both water and air in the coolant channels; k_∞ and f for the concentric tube in an 8.375-inch lattice, water cooled only; and k_∞, f, and p for the solid fuel in a 10.5-inch graphite lattice, water and air cooled. The effective fraction of the internal surfaces for resonance capture was determined to be 0.50. The average value of η for natural uranium in these lattices was found to be 1.30. (auth)

11404 EXPEDITING DANGER-COEFFICIENT MEASUREMENTS BY MEASURING TWO SAMPLES AT ONCE. Charles Erwin Cohn (Argonne National Lab., Ill.). Nucl. Sci. Eng., 18: 140-2(Jan. 1964).

A method for measuring very small reactivity changes is described. The method makes it possible to use the measuring time more effectively and reduces fuel activation by measuring two samples at once. (C.E.S.)

11405 THEORETICAL INTERPRETATION OF THE BEHAVIOR OF WATER-MODERATED REACTORS DURING RAPID POWER TRANSITION. R. Galvagni, A. Cuocu, L. Pucciarelli, and R. Scafè. Riv. Ing. Nucl., 1: 159-76 (July-Aug. 1963). (In Italian)

The behavior of water-moderated reactors subjected to rapid insertion of reactivity is considered theoretically, and the results obtained are reported. The problem is presented as one of reactor kinetics in which the variations of reactivity caused by power variations, the energy developed, the temperature, and boiling phenomena present during the surge are considered. The phenomena of thermal exchange in the absence of boiling are described. The thermal laws controlling boiling are then given, and the formation of vapor and spatial propagation of the boiling zone are discussed. The effects of dynamic pressures on the generation of boiling voids are determined. The single reactivity coefficient is evaluated. (J.S.R.)

11406 FACTORS INVOLVED IN THE TIME TO START UP FAST REACTORS, INCLUDING THE MEASUREMENT OF SUBCRITICAL REACTIVITY. D. C. G. Smith (United Kingdom Atomic Energy Authority, Dounreay Experiment Reactor Establishment, Caithness, Scotland). 19p. (CONF-334-22)

From Conference on Breeding Economics, and Safety in Large Fast Power Reactors, Argonne, Ill., Oct. 1963.

Factors influencing the permissible rate of reactivity addition, measurements of subcritical reactivity, and differential fuel reactivity are discussed. (R.E.U.)

11407 CALCULATIONS OF SODIUM VOID REACTIVITY EFFECT FOR LARGE FAST OXIDE REACTORS IN SPHERICAL AND SLAB GEOMETRY. H. H. Hummel, K. Phillips, and A. Rago. 21p. (CONF-334-9)

From Conference on Breeding Economics, and Safety in Large Fast Power Reactors, Argonne, Ill., Oct. 1963.

The uniform removal of sodium from the core of a large fast reactor is discussed. Calculations were performed using the ELMOE program for oxide-fueled reactors with sodium contents of 52, 59, and 70 vol-% with stainless steel structural material. (R.E.U.)

11408 SOME CALCULATIONS CONCERNING THE INFLUENCE OF RESONANCE OVERLAPPING ON THE DOPPLER EFFECT IN A DILUTE FAST REACTOR. J. Codd and P. J. Collins (Atomic Energy Establishment, Winfrith, Dorchester, Eng.). 17p. (CONF-334-7)

From Conference on Breeding Economics, and Safety in Large Fast Power Reactors, Argonne, Ill., Oct. 1963.

Approximate calculations are made of the Doppler change in neutron absorption at 1 kev when the overlapping of Pu^{239} resonances, and of Pu^{239} and U^{238} resonances, are separately taken into account. The validity of the assumption of constant collision density near a U^{238} resonance is also examined. The calculations refer to an infinite medium with composition representative of a large plutonium–uranium oxide fueled reactor. (auth)

Design and Feasibility

11409 (BNL-815) NONLINEAR KINETICS OF A TWO-TEMPERATURE REACTOR. Louis M. Shotkin (Brookhaven National Lab., Upton, N. Y.). Aug. 1963. Contract AT-30-2-GEN-16. 17p.

A nonlinear analysis of parameter regions in the two-temperature reactor stability problem is accomplished by using methods developed in the USSR for treating ordinary differential equations. It is shown that in a model such that both temperature-dependent quantities obey Newton's law of cooling, stable limit cycles exist; and centers do not exist. If one of the quantities obeys an adiabatic cooling law, centers exist; and stable limit cycles do not exist. A method is given for calculating the amplitude and frequency of limit cycles, as well as centers. Solutions with finite escape time are found to exist for certain sets of parameters and initial conditions. Finally, when at least one linear characteristic root vanishes, it is shown that a first integral exists and that it is possible to discuss reactor behavior in terms of this integral. (auth)

Fuels

11410 (EUR-521.e) HEAT TRANSFER IN A FUEL ELEMENT GAS GAP. S. Giuliani and C. Mustacchi (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 27p.

The effects of gas accommodation of noble gases on uranium monocarbide and aluminum surfaces are investigated. The results are used to estimate the temperature drop in the fuel-clad clearance of a fuel element. (auth)

11411 (GEAP-3771-11) HIGH PERFORMANCE UO_2 PROGRAM. Quarterly Progress Report No. 11, October–December 1963. B. Weidenbaum (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Jan. 15, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 58p. (EURAEC-944)

The irradiation of fuel assembly EPW-12V, which con-

sists of rods loaded with vibratory compacted arc-fused uranium dioxide powder to an apparent bulk density of 83 to 85%, was started in the GETR Pressurized Water Loop cycle 47 and continued throughout cycles 48, 49, and 50, without incident, to an average exposure of about 2.1×10^{20} f/cm^3 (7600 Mwd/te). The operating details of the PWL during GETR cycles 46, 47, 48, and 49 are given. Further examination of the failed rod (12D) in fuel assembly EPT-12 has revealed a section in which molten UO_2 was forced through cracks toward the cladding. The first instance remote from a failure in which alpha to alpha plus beta transformation in an operating fuel rod was found in a small area in the cladding in the 12D fuel rod. Detailed metallographic examination of the area near the pinhole failure in cored pellet rod 12B of fuel assembly EPT-12C-A reveals that a larger axial crack or inclusion existed below the surface. This subsurface crack is undoubtedly responsible for the large signals obtained during ultrasonic testing. An axial metallographic section at the top of the 12AV rod in the fuel assembly EPW 10/12V showed unequivocally that molten UO_2 reached the cladding over a distance of about $\frac{1}{2}$ inch. Phase transformation to the extent of 1/3 of the cladding thickness occurred where the molten fuel reached the cladding. The heat flux during the brief period that molten UO_2 was in contact with the cladding is 4 to 5×10^6 Btu/hr-ft^2. A burnout condition did not ensue from this operating situation. Structural limitations of tungsten has necessitated the substitution of rhenium for the bulb to be used as a gas in the thermal conductivity measurement of uranium dioxide at very high temperatures. Runs with tungsten bulbs served to shake down the calibration system and associated equipment. Discrepancies in the pressure-temperature relation obtained during the tungsten bulb calibration runs may be associated with the presence of iron tungstate which is present as a result of the vapor deposition technique used to fabricate the bulbs. An equation is obtained to express the grain size-time relation for uranium dioxide. A reproducibility of 10% in grain size was obtained when six pellets were heat treated isothermally at 2300°C for one hr. (N.W.R.)

11412 (HW-80391) COMPARISON OF BOILING BURNOUT DATA FOR NINETEEN-ROD BUNDLE FUEL ELEMENTS SPACED WITH "WIRES" AND "WARTS." J. M. Batch and G. M. Hesson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 15, 1964. Contract AT(45-1)-1350. 17p.

Boiling burnout heat fluxes were determined for an electrically heated model of 19-rod bundle fuel elements using warts to maintain the 0.050-inch spacing between rods. The test section was $19\frac{1}{2}$ inches long, and the spacers were located $6\frac{1}{4}$ inches from each end of the test section. The test section was identical in all respects to one used previously except that the earlier test section used wire wraps on 12 of the rods to maintain the rod spacing. The experiments were made at a pressure of 1200 psig and at mass velocities for 500,000 to 5,000,000 lb/hr-sq ft. Exit conditions ranged from enthalpies of 350 to 700 Btu/lb. Boiling burnout heat fluxes ranged from 270,000 to 1,600,000 Btu/hr-sq ft. The data show almost no difference between the boiling burnout heat fluxes of test sections using wire wraps or using warts for rod spacing. (auth)

11413 (EURAEC-815) "ARMOR" 1962 — FIRST YEAR OF ACTIVITY (E.L. 3 SAMPLES). Test Report No. 312. Special Report No. 13. Y. Artur and M. Beraud (France. Commissariat à l'Énergie Atomique, Paris and France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Feb. 1963. Work Performed under United States–Euratom Joint Research and Development Program. 31p. (A translation)

Progress made in the development of the Armor alpha gamma chain process for the analysis of irradiated Saclay Reactor (EL-3) fuel is reported. The process determines the uranium/plutonium ratio, measures plutonium isotope composition, and measures uranium depletion. Modifications to the laboratory equipment and the process are shown for the quantitative analytical technique. (N.W.R.)

11414 (TID-7672(p.288-302)) ISOTOPIC COMPOSITION EXPERIMENTS WITH BOILING WATER REACTOR FUEL. M. R. Hackney, D. L. West, and R. Protsik (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.).

Measurement of the isotopic content of irradiated fuel proved to be a valuable method for determining some of the important nuclear characteristics in an operating reactor. In particular, measurements at relatively low exposures provide data directly related to the initial conversion ratio of the fuel, while measurements at higher exposures provide data directly related to the relative effective capture cross sections in the transuranic isotopes. Although direct measurement of basic cross sections is not feasible through experiments of this type, an excellent evaluation can be made of the combined analytical methods used in predicting the nuclear performance of reactor fuel. The irradiated fuel was obtained from two operating boiling-water reactors. These two reactors are: the Dresden (samples are from the 1.5%-enriched first core loading) and the Vallecitos Boiling Water Reactor (fuel is 2.8%-enriched uranium oxide in zircaloy clad). The irradiated fuel was analyzed for the isotopic content of uranium and plutonium. Pellets were analyzed with exposures ranging from 100 to 3200 Mwd/T. The moderator steam fraction varied from 0 to 30% over the length of the fuel. The fuel exposure was determined by measuring the concentration of four fission products. Plutonium-to-uranium ratios were determined by alpha measurements, and isotopic distribution within plutonium and uranium were obtained from mass spectrometric analysis. The comparisons that were made between calculated and measured values for the relative abundance of the plutonium isotopes are summarized. From this comparison it was possible to infer that the analytical methods employed yield good values for the effective capture cross sections in Pu^{239} and Pu^{240} but consistently overestimate the effective cross section in Pu^{241}. Comparisons were made between measured production of Pu^{241} and that calculated with alternative assumptions concerning the self-shielding of the Pu^{240} resonance. (auth)

11415 MEASUREMENT OF THE THERMAL NEUTRON DISTRIBUTION ALONG THE RADIUS OF PLUG-TYPE FUEL ELEMENTS. V. F. Belkin, B. P. Kochurov, and O. V. Shvedov. At. Energ. (USSR), 15: 377-81(Nov, 1963). (In Russian)

Reactor systems including high-boiling organic liquids, such as monoisopropyl diphenyl as heat-transfer agents and natural U as the fissionable material require a multilayer fuel element design, for which the previously developed calculation methods are not applicable. Therefore, the neutron density distribution was determined experimentally in mocked-up plug-type fuel elements, containing Al-clad metallic natural U, a Mg spacer, and the organic liquid arranged in layers of varying thicknesses. The neutron density measurements were carried out by means of activation technique, using a polymer and Dy oxide type

detector. Determinations were made for 23 cases, for which the density distribution was also calculated by solving the Wigner–Seitz equation. The calculations allowed the dimensions of the equivalent cells, at which the neutron distribution in the internal monoisopropyl diphenyl layer was the same as required by the theory, to be determined. The effect of the Al layer was taken into account in the calculations. It could be shown that the neutron density distribution in heavy water-moderated, organic-cooled fuel elements agrees with the results of the calculation based on the single-velocity model $T_n^U = 1.3T_n^0$; $T_n^M = T_n^0$. (TTT)

11416 ADVANCED REACTOR CONCEPT STUDIES AT McGILL. Wan-yong Chon (McGill Univ., Montreal). Can. Nucl. Technol., 3: 41-4(1964).

Fluid flow and heat transfer problems related to advanced reactor concepts are investigated. Attempts to develop a mobile fuel system for reactors are described. The enhancement of nucleate boiling heat transfer rates in conventional boiling-water reactors is also discussed. (C.E.S.)

11417 IN-PILE PERFORMANCE OF CERAMIC COATED-PARTICLE FUELS. C. W. Townley, N. E. Miller, R. L. Ritzman, and R. J. Burian (Battelle Memorial Inst., Columbus, Ohio). Nucleonics, 22: No. 2, 43-8(Feb. 1964).

Programs of research in ceramic-coated particle fuels are reviewed. The preparation and requirements of coated fuels are discussed. Pyrolytic carbon, aluminum oxide, and beryllium oxide coatings for uranium carbides and oxides are considered. (R.E.U.)

11418 STATISTICAL QUALITY CONTROL IN THE MANUFACTURING OF REACTOR FUEL ELEMENTS. Robert K. Ruzicka (Allis-Chalmers Mfg. Co., Milwaukee). 21p. (CONF-80-6)

From Institute of Nuclear Materials Management 4th Annual Meeting, Buffalo, June 1963.

The standard techniques used in statistical quality control are presented. Sample control charts are shown. (R.E.U.)

11419 ELECTRIC GENERATING SYSTEMS. William E. Shoupp (to Westinghouse Electric Corp.). U. S. Patent 3,117,913. Jan. 14, 1964. Filed Sept. 27, 1957.

A thermopile arrangement applicable to reactors is described. The hot and cold junctions are adapted for heating and cooling by either gaseous or liquid heat transfer media. A fuel element with means for converting part of the fission heat directly into electricity is described. A heat exchanger and means for reducing turbulence in heat transfer liquid are described. Protective cladding of the thermopile arrangement is also described. (R.E.U.)

11420 NUCLEAR FUEL MATERIALS. William James Keith Wright and Jack Williams (to United Kingdom Atomic Energy Authority). U. S. Patent 3,117,914. Jan. 14, 1964. Priority date Dec. 5, 1956, Great Britain.

A cermet of ferrous metal with uranium dioxide and alumina particles uniformly dispersed within is suggested as reactor fuel. The total amount of uranium dioxide and alumina is not more than 50 vol % of the cermet and the material is enclosed in a ferrous metal sheath. (R.E.U.)

11421 NUCLEAR FUEL CARTRIDGE. Lucien Alfille and Jean Ropers (to Commissariat a l'Energie Atomique). U. S. Patent 3,118,819. Jan. 21, 1964. Priority date Nov. 18, 1958, France.

A fuel cartridge is described consisting of a sheath and a sheath plug, which is subject to plastic distortion under reactor operating conditions. The sheath and plug are made of magnesium or aluminum, and at least one annular member of the cartridge is made of stainless steel, beryllium, sintered alumina, or sintered aluminum powder, and encompasses and engages the body of the plug. (R.E.U.)

11422 CERAMIC COATED FUEL PARTICLES. L. D. Stoughton, J. M. Blocher, Jr., and N. D. Veigel (to U. S. Atomic Energy Commission). U. S. Patent 3,121,047. Feb. 11, 1964.

The fuel particles consist of a pellet of UO_2 with an outer layer of impervious Al_2O_3 and an interlayer of porous Al_2O_3 of thickness greater than the recoil range of fission products. The porous layer becomes a sump to absorb certain fission products, especially those which are gaseous, without imposing excessive pressures on the impervious outer layer. (AEC)

11423 NUCLEAR REACTOR FUEL ASSEMBLY. Clifford W. Wheelock (to U. S. Atomic Energy Commission). U. S. Patent 3,121,666. Feb. 18, 1964.

A reactor and fuel element design for the direct generation of superheated steam are described. A reactor core filled with water and having a multiplicity of fuel element assemblies with outer cylinder and inner nested cylinders is described. Fuel located within the two annular spaces formed by the cylinders heats the water to superheated steam. Saturated steam is produced in the outer annular region of the fuel element assemblies and then separated for passing downward in the concentric inner annular space for superheating. The superheated steam exits upward through the innermost tube of the fuel assembly. (AEC)

11424 COHERENT NUCLEAR REACTOR ELEMENTS. Joseph H. Handwerk and Eugene D. Lynch (to U. S. Atomic Energy Commission). U. S. Patent 3,122,509. Feb. 25, 1964.

A ceramic metal-clad fuel consisting of 10 to 90 wt % of a binder glass (conventional glass plus 10 to 90 wt % of uranium or plutonium oxide), the remainder being oxide, nitride, carbide, or sulfide of uranium or plutonium, and also the process of making the fuel are described. (AEC)

11425 CONTROLLED NUCLEAR REACTOR DISPERSIONS AND METHOD OF MAKING. Joseph H. Oxley (to U. S. Atomic Energy Commission). U. S. Patent 3,122,595. Feb. 25, 1964.

A process of equidistantly distributing nuclear fuel particles in a matrix is described. The fuel particles are coated to obtain spheres of uniform size, which then are arranged in a close-packed configuration. A gas decomposable into a solid product (methane; metal carbonyl; $AlCl_3$ + steam; $ZrCl_4$ + steam; chromyl chloride + hydrogen) is diffused through the configuration at above decomposition temperature, whereby the interstices of configuration are filled with the solid decomposition product. (AEC)

Power and Power-Breeder Reactors

11426 (ACNP-63582) QUARTERLY TECHNICAL REPORT NO. 1 CONCERNING PROGRESS OF THE LA CROSSE BOILING-WATER REACTOR RESEARCH AND DEVELOPMENT PROGRAM. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). July 1963. Contract AT (11-1)-589. 49p.

Submitted as Amendment No. 2 to Application for Construction Authorization Docket No. 115-5.

Progress made in the development of the La Crosse Boiling Water Reactor is reported. Information is included on: in-core flux monitoring system, failed-fuel location system, control-rod drive mechanism, steam separators, steam dryers, dynamic analysis, analysis of control-rod-drop accident, and burnout heat-flux safety factor evaluation. (N.W.R.)

11427 (ACNP-63624) QUARTERLY TECHNICAL REPORT NO. 2 CONCERNING PROGRESS OF THE LA CROSSE BOILING-WATER REACTOR RESEARCH AND DEVELOPMENT PROGRAM. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Nov. 1963. Contract AT(11-1)-654. 71p.

Submitted as Amendment No. 4 to Application for Construction Authorization Docket No. 115-5.

Progress made in the development of the La Crosse Boiling Water Reactor is reported. Information is included on: in-core flux monitoring system, failed-fuel location system, control-rod drive mechanism, steam separators, steam dryers, dynamic analysis, burnout heat-flux safety factor evaluation, and scram valve test. (N.W.R.)

11428 (AEEW-M-314) A METHOD OF SIMULATING VOIDS IN EXPERIMENTAL STUDIES OF BOILING WATER REACTORS. H. J. Down, J. Dickie, and W. N. Fox (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Nov. 1963. 22p.

The effect of reduced water density on reactivity in unpressurized experimental systems can be studied by packing small beads of highly expanded polystyrene into the fuel clusters and flooding the interstices with water. Coolant densities of 0.4 to 0.6 gm/cm^3 may be produced with the introduction of only about 0.4 gm/cm^3 of nonhydrogeneous material. The production, properties and handling of polystyrene beads and the tests carried out to establish the validity of the technique are described. (auth)

11429 (CEND-175(Vol.I)) ORGANIC COOLED, HEAVY WATER MODERATED REACTOR POWER PLANT CONCEPTUAL DESIGN AND EVALUATION. VOLUME I. EVALUATION OF THE CONCEPT. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Mar. 1963. Contract AT(10-1)-1150. 55p.

The results of an economic evaluation and appraisal of the heavy-water-moderated, organic-cooled concept for a 500 Mw(e) plant are presented; and the research and development program required to establish the concept is discussed. (D.C.W.)

11430 (CEND-175(Vol.II)) ORGANIC COOLED, HEAVY WATER-MODERATED REACTOR POWER PLANT CONCEPTUAL DESIGN AND EVALUATION. VOLUME II. REFERENCE PLANT DESIGN. (Combustion Engineering Inc. Nuclear Div., Windsor, Conn.). Mar. 1963. Contract AT(10-1)-1150. 248p.

Includes Appendices A through G.

The design and analysis of the 500-Mw (electrical) reference plant that uses a 1550-Mw (thermal) pressure-tube reactor fueled with either natural or enriched uranium are described. The plant and reactor characteristics are summarized. (D.C.W.)

11431 (CVNA-198) MONTHLY OPERATING REPORT, DECEMBER 1963. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). 42p.

The CVTR was successfully operated at 30.6 Mw gross thermal power producing 12,000 kwh of electrical power. The startup test S.U. CV-45, "Moderator Temperature Coefficient, Primary Coolant Temperature Coefficient, Primary Coolant Pressure Coefficient" was interrupted when the low temperature conditions of sections of the test appeared to aggrevate the fluoride contamination problem in the moderator and header cavity drains. Considerable increases in radiation and air contamination levels, as well as fairly high radioactivity levels in the moderator and primary coolant, were observed during the power operation. Further reactor operations were curtailed after the power run, and the fluoride contamination problem was subjected to intensive study in an attempt to determine the source and extent of the contamination, as well as to find a solution to the problem. (auth)

11432 (DP-875) HEAVY WATER MODERATED POWER REACTORS. Progress Report, September–October 1963. R. R. Hood, comp. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Dec. 1963. Contract AT(07-2)-1. 43p.

Irradiation tests of Zircaloy-clad uranium oxide tubes and uranium metal tubes continued in the Heavy Water Components Test Reactor (HWCTR). Two irradiation failures occurred in assemblies of uranium oxide tubes that operated at high power ratings ($\int kd\theta > 50$ w/cm). A 10-foot-long tube of unalloyed uranium metal clad with Zircaloy exhibited 1% cladding strain after irradiation to 3700 Mwd/tonne. It is predicted from an analysis of test irradiation experience that compacted tubes of fused uranium oxide fabricated by current methods should operate satisfactorily at an $\int kd\theta$ of 30 watts/cm to exposures of at least 20,000 Mwd/tonne U. Tandem-extruded tubular joints of Zircaloy and stainless steel were undamaged by irradiation to fast neutron exposures as high as 7.8×10^{20} neutrons per square centimeter. A preliminary economic analysis of D_2O-moderated reactors that are cooled by boiling H_2O indicates a modest cost advantage for boiling H_2O in comparison with liquid D_2O cooling (0.2 mill/kwh for privately financed 1000-Mwe reactors). (auth)

11433 (EUR-425.i) CENTRALE ELETTRONUCLEARE DEL GARIGLIANO RELAZIONE GENERALE ANNUALE. (Electronuclear Power Station at Garigliano Annual General Report). Società Elettronucleare Nazionale, Rome). Mar. 1963. 46p.

By the end of 1962, after almost three years of construction, the Garigliano nuclear power plant with a boiling water reactor was almost complete. The modifications made to the original design of the core, neutron flux detection system, detection of burst fuel elements, liquid poisoning system, control rods, and liquid processing system are briefly reviewed. The construction on the containment sphere and auxiliary buildings is described. Components and circuits testing, personnel, and costs and space estimates are also briefly considered. (J.S.R.)

11434 (GEAP-4486) DEVELOPMENT PROGRAM FOR THE GARIGLIANO NUCLEAR REACTOR. Quarterly Report No. 5. T. Sorlie (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Jan. 1, 1964. Work Performed under Joint United States–Euratom Research and Development Program. Contract AT(04-3)-189. 11p. (EURAEC-941)

Effort was directed toward the power distribution calculational module. Trial calculations using the on-line equations were performed and results indicate that the method is quite fast and provides good power shapes. Two flux iterations per minute are achieved on a Philco S-2000 computer for the full SENN three-dimensional core representation. The use of in-core monitor readings as internal

boundary conditions was investigated. Inclusion of in-core monitor effects promises a more rapid convergence of the power calculation after a large change in reactor power level or power shape. (auth)

11435 (HW-79054(p.21-30)) DELAYED NEUTRON PARAMETERS AND REACTIVITY MEASUREMENTS IN THE PRCF. L. C. Schmid (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The abundances of delayed neutrons in the Plutonium Recycle Critical Facility were calculated, and the sensitivity of measurements of reactivity differences to changes in the abundances was determined. (D.C.W.)

11436 (HW-79054(p.31-42)) NEUTRON SPECTRUM MEASUREMENTS IN THE PLUTONIUM RECYCLE CRITICAL FACILITY. B. Arcipiani and L. C. Schmid (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The spectral index characterizing the thermal component of the neutron spectrum and the parameters r characterizing the relative intensities of the 1/E and thermal components of the spectrum were measured in an Al thimble in the center of the Plutonium Recycle Critical Facility by the Lu activation technique. The thimble contained a Pu–Al rod cluster with no moderator for one measurement; a single Pu–Al rod in light water was used in the other measurement. UO_2 and Pu–Al rod clusters formed the rest of the core. (D.C.W.)

11437 (IA-795) NUCLEAR POWER STATIONS IN ISRAEL. First Report of the Nuclear Reactors Committee. S. Yiftah, M. Barak, G. Ben-David, D. Dagan, M. Nelken, Z. Pelled, and J. Tsur (Israel. Ministry of Defence and Israel. Atomic Energy Commission, Tel-Aviv). May 1962. 127p.

A study is made of the conditions under which it would be feasible to construct and operate a nuclear power station in Israel. The generation and future requirements of electricity in Israel are reviewed. The economic and technological aspects of nuclear power are discussed. It is concluded that a 125-Mw nuclear power station by 1948 is possible, but that sites on the coast have to be chosen now for possible future use. (D.L.C.)

11438 (RT/ING(63)-20) PERDITE DI CARICO SULL' ELEMENTO DI COMBUSTIBILE DEL 1° NOCCIOLO DEL PRO—RILIEVI SPERIMENTALI. (Pressure Loss Across 1st Core Fuel Elements of PRO—Experimental Results). S. Di Leo and L. Matteuzzi (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). July 1963. 24p.

Total pressure drops across 1st PRO core fuel element are estimated for Santowax at 300, 325, and 350°C. The values came from experimental data with water at 30°C. (auth)

11439 (SWRI-5-1348-7-2) EVALUATION OF THE SERVICEABILITY OF THE ELK RIVER REACTOR PRESSURE VESSEL. Progress Report No. 2, August 1, 1963–September 30, 1963. (Southwest Research Inst., San Antonio). Contract AT(11-1)-1228. 4p.

The development of a program for evaluating the serviceability of the Elk River Reactor pressure vessel by determining the effect of fabrication procedures, dissimilar weld metallurgy and geometry, and irradiation on the nil-ductility transition temperature and fatigue life of the completed vessel is described. The development of remote nondestructive testing equipment and techniques for the detection and monitoring of gross defects in critical areas of the vessel is discussed. (N.W.R.)

11440 (TID-7672) NUCLEAR PERFORMANCE OF POWER-REACTOR CORES. ANS Topical Meeting Sponsored by the Northern California Local Section of the American Nuclear Society, September 26-27, 1963, San Francisco. (American Nuclear Society, Hinsdale, Ill.). 474p.

Twenty-three papers and one panel discussion presented at the ANS topical meeting on Nuclear Performance of Power-Reactor Cores are given. Separate abstracts were prepared for 12 papers and the panel discussion. Eleven papers were previously abstracted for NSA. (M.C.G.)

For abstracts of individual papers see: 11367, 11399, 11414, 11441, 11442, 11443, 11444, 11445, 11446, 11447, 11448, 11449, and 11450.

11441 (TID-7672(p.1-32)) NUCLEAR PERFORMANCE OF YANKEE CORE I. H. W. Graves, Jr. (Westinghouse Electric Corp. [Atomic Power Div., Pittsburgh] and J. E. Howard (Connecticut Yankee Atomic Power Co., Boston).

The Yankee reactor has successfully operated through two core lives and a net energy production in excess of two billion kw hours. Extensive physics experiments and a program of spent-fuel examination yielded an opportunity to evaluate the nuclear performance of this reactor type. An in-core instrumentation system consisting of both thermocouples and remotely operated flux wires permitted continuous evaluation of the core power distribution. Operating data on temperature coefficient, power coefficient, fission-product poisoning, and reactivity depletion rate were obtained and compared with calculation. A large number of spent fuel rods from Core I with burnups up to 15,000 Mwd/MTU were subjected to gamma-spectrum analysis, radiochemical analysis, and isotopic analysis to evaluate the relationships between burnup, fission-product activity, U^{235} depletion, and production of plutonium isotopes. Both experimental and calculated reactivity and power-distribution data were evaluated. The information obtained from these cores was useful both in design and operation of subsequent cores. (auth)

11442 (TID-7672(p.71-94)) NUCLEAR PERFORMANCE OF BOILING WATER REACTORS—AN EVALUATION OF REACTOR OPERATING DATA AND REACTOR CALCULATIONS. R. J. McWhorter and G. R. Parkos (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.).

Several types of experimental information are available from operating reactors for the purpose of checking the validity of nuclear design methods, including such items as: reactivity measurements for various critical configurations, reactivity and power coefficients, power-distribution information, transient response characteristics, reactivity loss due to burnup, and spent-fuel isotopic compositions. This type of information was obtained from several boiling-water reactors. The list of reactors from which data was obtained and analyzed includes Dresden, SENN, Humboldt Bay, RWE, and Vallecitos Atomic Laboratory BWR. In addition to normal operating data and data obtained from the startup test programs, several special tests and measurements were performed to provide additional experimental data to check the validity of nuclear design methods and the validity of design bases. The types of data obtained are discussed, and typical comparisons between calculations and observations are presented for each of the above areas. Particular emphasis is placed on reactivity data, reactivity-coefficient data, and power-distribution data. In general, it was found

that current nuclear design methods can predict the observed behavior of operating boiling-water reactors quite well for the clean (non-depleted) core. Most of the reactivity predictions for a variety of critical configurations in several different reactors are within 1% Δk_{eff} of critical. Predicted reactivity and power coefficients are also in good agreement with experimental data for these cases. Predictions of reactor-power distributions are generally in good agreement with experimental measurements in that the deviations are within the uncertainty of the experimental data. For the case of depleted cores, agreement between calculations and observations to date is satisfactory, but in some cases the data are less accurate and there is much less experimental information available. (auth)

11443 (TID-7672(p.95-122)) NUCLEAR PERFORMANCE OF NPD. A. C. Whittier (Canadian General Electric Co., Ltd., Peterborough, Ont.).

NPD went critical April 12, 1962 and reached full power June 29, 1962. The reactor is moderated and cooled with D_2O, fueled with Zircaloy-2-clad UO_2 in horizontal 3¼ inch ID pressure tubes, and controlled by moderator-level variation. First criticality was achieved by raising the moderator level. A reactivity scale was established by calibrating the moderator level against $CdSO_4$ poisoning in the coolant. Reactivity measurements on the clean reactor included the measurement of the moderator temperature coefficient, fuel-channel temperature coefficient, and the power coefficient. Also measured was the worth of the enriched U/Al booster rod (used for partially overriding the Xe^{135} poison shutdown transient) and the worth of the light-water reflector surrounding the reactor. To compensate for the lack of burnup load, about 4% of the fuel was initially replaced by depleted fuel (0.24 wt % U^{235}). This caused considerable flux distortion. The calculation of reactivity was therefore complicated by both an unsymmetric geometry and a distorted flux. Comparisons of calculated and measured effects were made. To facilitate on-power fueling, the fuel is in the form of 7 and 19 element bundles 19½ inches long. There are nine bundles to each fuel channel. After start-up some fuel was shifted around in the core so the relationship between the measured and calculated effects of burnup is somewhat complicated. Calculations and measurement are compared. Power distribution, photo-neutron source after an extended shut-down, D_2O purity, and the effect on reactivity of introducing a new fuel bundle are discussed. (auth)

11444 (TID-7672(p.123-56)) REACTIVITY CALCULATIONS AND MEASUREMENTS AT THE SRE. R. W. Keaten and E. N. Pearson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

Original calculations of the nuclear properties of the SRE with the second fuel loading on thorium/uranium fuel clusters were performed using standard two-group techniques. A comparison of the measured values of the critical mass, sodium worth, statistical weight, flux distributions, and temperature coefficients with these calculated values revealed a discrepancy larger than the expected calculational error. Further analysis demonstrated that this discrepancy was associated with the improper treatment of the epithermal fissions in the reactor. This factor is important in calculations of this core loading because of the high enrichment of the fuel (7.1 wt % U^{235}). Revised physics calculations (which included fissions above the thermal energy range) utilized thorium and U^{235} resonance intervals calculated by a Monte Carlo Code, and the results agreed very well with the measured values. These parameters along with approximate calculations of the effect of xenon, samarium, and fuel burnup were used to formulate a reactivity history code that compares the excess reactivity calculated from reactor power and temperatures to the measured reactivity obtained from the positioning of the shim rods. This calculation is performed every two hours using an IBM 7090. It was further necessary to adjust the values used for the reactivity worth of xenon, samarium, and the parameters for fuel burnup in order to obtain a good agreement between predicted and measured reactivity. With these improvements, the average agreement was within 30¢ over a period of two years, and improved calculations justified the adjustments made in the code. As a result of this success, equipment was purchased to provide an on-line reactivity meter, which uses analog-computer components to calculate the reactivity, and analog-function generators to convert the critical shim-rod positions to reactivity. The xenon computer was designed to provide stability during continuous operation for several months and demonstrated this capability. The remaining components are still in the process of being checked out. (auth)

11445 (TID-7672(p.211-26)) PHYSICS OF NATURAL URANIUM–GRAPHITE POWER REACTORS. P. Bacher (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay) and F. Minnard (France. Electricité de France, Paris).

Preliminary work in France on the physics of natural-uranium graphite-moderated power reactors was started about ten years ago. Studies were made of the reactivity of cold and hot lattices. The lattices studied in MARIUS ranged from a 7.6 to a 12.5 in. pitch, and 2.76 to 5.51 in. channel diameter. About 20 fuel-element geometries ranging from 1.1 to 2.52-in. diameter solid rods, and from 0.25 × 1.2 in. to 3.54 × 4.05 in. diameter tubes were tested in one or more pitches. The Amouyal/Benoist/Horowitz theory for thermal utilization was found in good agreement with transport calculations (S_n and double P_n) and experiments. Benoist's theory was applied to streaming corrections and compared to measured values of anisotropy. The fast fission factor was calculated by a method derived from Spinrad. The spectrum models proposed by Horowitz and Trétiakoff were applied to the effective cross sections of uranium and plutonium isotopes, and checked against spectrum index measurements (Pu/U fission ratios, Lu/Mn activation ratios, etc.). Integral correlation carried out on the basis of the MARIUS experiments and these theories yielded ν_{235} and the effective resonance integral for U^{238}. The former is in good agreement with published values: $\sigma_{eff}^{238} = 4.55 + 48$ S/M and $\nu^{235} = 2.418 \pm 0.010$. A two-month experimental program on control and power distribution carried out during commissioning of EDF-1 in the spring of 1963 supplemented work carried out in MARIUS on control-rod worths and flux distribution both without and with rods inserted in the core. It showed good agreement with the two-group, two-dimensional diffusion calculations used. Calibration of control rods by control-rod oscillation was successful. Information on long-term irradiation was derived from the operation of the G_2 and G_3 reactors. Both synthetic U–Pu fuels and fuel elements were irradiated in the Marcoule reactors and in EDF-1. The physics measurements in MARIUS and CESAR are being supplemented by isotopic analysis of irradiated fuels. A major operational problem in natural-uranium/graphite reactors results from the large positive moderator temperature coefficients enhanc-

ing divergent spatial instability. Theoretical models were derived to solve those problems ($r-\theta$ and $r-z$ kinetic codes), which have to be tested against the actual behavior of reactors. Although both the Marcoule reactors and EDF-1 are too small for spatial effects to show up, their transient behavior following a perturbation yields most of the necessary information. A large number of experiments were carried out for increasing burn-up. (auth)

11446 (TID-7672(p.227-41)) NUCLEAR STARTUP EXPERIMENTS FOR HNPF. M. P. Aronchick (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

The nuclear startup experiments for HNPF provided a set of standard data against which the design methods, assumptions, and basic data used can be checked and the design evaluated. HNPF was operated at net power up to 170 Mw(th) with extensive testing at 100 kw(th), 2.5, 10, 20, and 38 Mw(th). The design power is 254 Mw(th). The nuclear tests and important data derived are discussed. The minimum dry critical loading was determined to be 30.6 elements compared to a calculated 23. The minimum wet critical loading was 52.6 elements compared to a calculated 37. The wet excess k at an isothermal temperature of 350°F for a 140-element loading was 7.5% compared to the predicted 6.9%. Sodium worth as determined from draining was approximately 4.3% against a predicted 5.0%. Control rods were calibrated in both partially loaded dry and wet cores and in the fully loaded wet core by integration of differential-rod-worth measurements. Total rod worth was measured as 12.5% $\Delta k/k$ compared to a predicted 12.7% $\Delta k/k$. The zero-power flow coefficient was negligible. The isothermal reactivity coefficient as measured between 370 and 541°F was +0.103 cents/°F. The worth of the control rods did not change appreciably with temperature. Changes in reactivity, along with associated time constants, were examined for changes in power level, coolant flow rate, system temperatures, and combinations of these factors by flow and power ramps. The prompt power coefficient measured at these lower powers is ~ -0.40 cents/Mw(th) with a time constant of 2.5 sec. The measured slow coefficient (time constant ~ 200 sec) is $\sim +0.5$ cents/Mw(th). These measurements are compared with predictions of -0.5 cents/Mw(th) and time constant of 2.5 sec and +0.6 cents/Mw(th) and time constant ~ 200 sec for the prompt and slow components respectively. Xenon poisoning was measured at 15% and 50% and extrapolated to 100% of full power. Results show good agreement with calculations. (auth)

11447 (TID-7672(p.242-6)) STARTUP, LOAD CHANGES, AND SHUTDOWN PROCEDURES FOR BOILING WATER REACTORS. R. O. Brugge (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.) and J. C. Carroll (Pacific Gas and Electric Co., San Francisco).

The normal, routine startup procedures and sequences of events from an operations-physics point of view are discussed for a 50-Mw(e) natural-circulation nuclear power station (Humboldt). The emphasis is an operational observables, using plant instrumentation, and follows: the approach to cold critical; power increase to heating power; reactor system warmup; turbine sealing, vacuum buildup, and turbine warmup; turbine parallel; power increase to rated conditions; and power distribution control. Variations are discussed for the 210-Mw(e) Dresden station, the 50-Mw(e) Big Rock Point station and the 16-Mw(e) Kahl station. Normal load-change procedures and rates are then discussed, followed by fast load-rejection behaviors. A special demonstration test at Kahl, where the load was increased from 33% to ~110% in less than 6 seconds, is also described. The normal unloading, shutdown, and cooling procedures and sequence of events is discussed. (auth)

11448 (TID-7672(p.247-58)) DRESDEN REFUELING AND PHYSICS TESTING RESULTS. C. E. Foreman (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.) and A. F. Veras (Commonwealth Edison Co., Chicago).

Power operation of the first core of the Dresden reactor was terminated on November 7, 1962 after generation of more than two billion kilowatt hours of electrical energy. Prior to the shutdown, a series of core-performance tests was conducted. Rate of withdrawal of control rods with core exposure (at fixed primary steam flow rate) was 5.2 ± 0.8 rods/1000 Mwd/Ton. Rate of loss of primary steam flow rate capability at fixed rod position was $860{,}000 \pm 60{,}000$ lb/hr/1000 Mwd/Ton. Core average exposure at time of derating was 4482 Mwd/Ton (ten control rods partially inserted for power shaping). Core average exposure at shutdown was 4940 Mwd/Ton (at 530 Mw(th), having derated primary steam flow rate by 600,000 lb/hour). Core average exposure at all-rods-out end of full power life-time was 4758 ± 22 Mwd/Ton. Power worth of ten control rods partially inserted in core at end-of-life for power shaping 455 ± 85 was Mwd/Ton. Before removal of the reactor head, the temperature coefficient of reactivity was measured as a function of temperature and found to be substantially less negative than at the beginning of life, as expected. The coefficient was negative above 290°F. It was found that 19 control rods could be withdrawn from a closely packed volume in the center of the core for cold criticality, whereas, at zero exposure, the reactor could be made critical by withdrawal of three adjacent control rods. The minimum critical size of an array of stainless steel-clad, Type-II fuel was 28 fuel assemblies. An exposure-distribution test was conducted in a small critical array by measuring the reactivity of the core with each of a series of selected exposed Type-I fuel assemblies in a test location. The resulting distribution of core reactivities indicated that the distribution of exposure within the sample of exposed assemblies was as expected. Results of reactivity tests on two highly exposed control blades and one unirradiated blade indicated that there was no apparent change in the poison worth of the blades with exposure. After this testing and required inspection work, the discharge of 182 exposed Type-I, one exposed Type-II, and seven exposed developmental fuel assemblies as completed and the reactor was refueled with 80 new Type-I, 106 new Type-II, and four partially exposed Type-I fuel assemblies. The partially exposed assemblies which remained in the reactor were 268 Type-I, one Type-II, and five developmental fuel assemblies. The central 384 fuel assemblies of the core were loaded such that each four-assembly-cell contained two exposed and two new fuel assemblies. This central region was surrounded by exposed fuel which was not moved. After the refueling was completed, the cold critical rod pattern was established and the shutdown margin was verified. The reactor head was then installed and the temperature coefficient of reactivity was measured at various temperatures. The cold critical rod pattern and coefficient data were as expected. During the rise to full power the calibration of the in-core monitors was satisfactorily completed and reactor dynamic-response tests were performed. The dynamic response was not significantly altered by the new fuel or

by exposure. The operating rod pattern at rated power was as expected, indicating that the operating reactivity increase provided by the new fuel in the scattered loading arrangement was in good agreement with expectation. (auth)

11449 (TID-7672(p.381-423)) NUCLEAR CHARACTERISTICS OF LARGE ADVANCED BOILING WATER REACTORS. R. L. Crowther and D. L. Fischer (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.).

The nuclear performance of large boiling-water reactors with neutron leakage less than 3% is discussed. Large BWR's, such as the Dresden reactor, are characterized by flexible neutron flux and power distributions which can be advantageously flattened by the use of bottom-entry control rods to balance the downward skewing effect of voids. Small spatial reactivity variations such as xenon and Doppler provide significant power-distribution flattening because the core is strongly decoupled and has small neutron leakage. The large negative power coefficient of reactivity, which occurs from moderator boiling, induces appreciable inherent self-flattening and provides sufficient damping to make the reactors stable to spatial xenon variations. As fuel exposure progresses, non-uniform fuel burnup results in power-distribution flattening and provides a means for improving the end-of-life power distribution with all control rods out. Appreciable additional flattening is possible through choice of the spatial distribution of fuel assemblies in refueling. A combined zone-scatter method provides good power distributions and minimizes the number of fuel assemblies that must be moved during partial batch refueling. Spatial distribution of burnable poisons in the initial core reduces control requirements and approximates the power flattening resulting from non-uniform fuel burnup in the equilibrium core. In large reactors that are strongly decoupled, spatially distributed burnable poisons are superior to zoned enrichment variation for design of the initial core. Spatial-dynamics analyses, which provide a time-space breakdown of the void, Doppler, control and xenon reactivity effects, contributed to improved understanding of the detailed dynamic nuclear performance of large BWR's. The long time constant of the oxide fuel rods contributes considerably to the stability and performance. A typical large BWR is capable of automatically regulating a severe transient such as complete loss of power to all pumps, without scram or excessive cladding and fuel temperatures. Power-distribution shifts during severe transients such as this are of considerable importance. In large single-cycle BWR's, flow control is a method for load following; it compares favorably with subcooling control which was used at the Dresden station. Both subcooling and flow control perturb the overall reactor and, therefore, are considered superior to load following with control rods (which perturb local regions and can result in localized power peaking). Considerable flexibility exists for variation of the detailed nuclear properties of large BWR's by variation of lattice design variables such as the distribution and type of fuel, the moderator-to-fuel volume ratio, and the fuel-rod diameter. Spatially distributed burnable and fertile poisons, plutonium recycle, space-variable water-to-fuel ratio, alternative fertile materials such as thorium, and use of soluble poisons in the coolant are alternative design concepts which provide potential for future improvement of nuclear performance. (auth)

11450 (TID-7672(p.446-57)) CALCULATED PERFORMANCE OF A LARGE NATURAL URANIUM–GRAPHITE GAS-COOLED POWER REACTOR. P. Bacher (France. Centre d'Etudes Nucleaires, Saclay).

A systematic theoretical and experimental study of natural-uranium/graphite lattices showed that fairly large fuel cross sectional areas and lattice pitches could be used without much loss in reactivity. If s_u be the fuel cross sectional area (in cm^2) and S/s_u (in cm^{-1}) the ratio of the fuel perimeter to the fuel cross sectional area, then for optimum moderator-to-fuel ratios: $(\delta k/k) = -0.001\ \delta s_u - 0.050\ \delta(S/s_u)$. With both internal and external cooling, it is then possible to look for large tubes. Heat-transfer calculations showed that the maximum specific power (with a coolant pressure of 40 bars) is of the order of 10.5 Mw/T for the tubes mentioned. Calculations were carried out both for 500- and 1000-Mw(e) reactors. Results showed that the trend toward high fuel cross sections opens the way to development of natural-uranium/graphite-moderated reactors. Roughly the same power density as in the AGR can be obtained. (auth)

11451 (WCAP-2525) 1000-MWE SUPERCRITICAL PRESSURE NUCLEAR REACTOR PLANT STUDY. Quarterly Progress Report No. 7, July 1, 1963–September 30, 1963. G. B. Brown and H. B. Kellogg, eds. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Oct. 1963. Contract AT(30-1)-2948. 84p.

The operation of the high-temperature supercritical-pressure heat transfer loop was continued. Basic heat transfer data were obtained from the loop with an 0.1-in. ID Hastelloy C test section with a two ft length, an 0.1-in. ID stainless steel test section with a two ft length, and an annular test section. Once-through supercritical pressure, DNB and post-DNB, and superheated steam data were obtained in the testing program. Reference heat transfer equations in sub- and supercritical-pressure regions were developed. The fabrication of the annular test section for single and two side heating was completed and installed. The design of the test section for the stress corrosion experiments was completed; fabrication is underway. Effect of a preliminary correlation on the design and cost of the 1000 Mw(e) SCOTT-R plant was determined. (auth)

11452 (EURAEC-832) HEAT TRANSFER IMPROVEMENT IN BOILING WATER REACTORS. Quarterly Report No. 14. (Société Nationale d'Étude et de Construction de Moteurs d'Aviation, Suresnes, France). Oct. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 058-61-7 RDF. 20p. (A translation)

Hydrodynamic and heat transfer studies of boiling reactors are discussed. Information is included on critical flux curves, fretting factor, and vacuum fraction. The thermal conductivity of irradiated urania fuel is evaluated. The advantages of introducing twisted tapes into a reactor are evaluated with respect to lattice shapes without box-shaped units. Elimination of the box-shaped units introduces a gain in the reactivity. (N.W.R.)

11453 STARTUP OF THE WORLD'S FIRST ATOMIC POWER STATION WITH AN ORGANIC-COOLED, ORGANIC-MODERATED REACTOR. Yu. Arkhangel'skiĭ and I. Kovalev. At. Energ. (USSR), 15: 443(Nov. 1963). (In Russian)

The Arbus power station started operation at 750 kw at the Melekess Reactor Institute on Aug. 11, 1963. The reactor represents a prototype of small reactors, designed to operate in remote areas of the Soviet Union. The reactor was designed, built, and assembled in 2 years; an organic

liquid is used as heat-transfer agent and moderator. The total thermal power of the reactor will be 5000 kw. Carbon steel was used for construction of the core components, steam generator, and the ducts of the primary circuit. The original loading amounted to 22.5 kg of U^{235}. The reactor regenerates its heat-exchange agent. (TTT)

11454 START-UP AND PERFORMANCE OF THE WINDSCALE A.G.R. Engineer, 215: 554-8(Mar. 29, 1963).

Plant tests before fuel loading, low power commissioning, high power commissioning, and full power operation of the Windscale A.G.R. are described. (C.E.S.)

11455 WINDSCALE ADVANCED GAS-COOLED REACTOR. No. II. (Concluded from page 511, March 22). Engineer, 215: 579-82(Mar. 29, 1963).

The moderator structure, heat removal system, fuel handling, containment and gaseous discharge, electric power plant, principal safety measures, commissioning and operation, and experimental uses of the Windscale A.G.R. are discussed. (C.E.S.)

11456 BRADWELL AND BERKELEY ON COMMERCIAL LOAD. Engineer, 215: 614-18(Apr. 5, 1963).

The main differences between the Bradwell and Berkeley power stations are described. The control rods, fuel charging, instrumentation and safety systems, routine testing of instruments, control rod calibration, flux shaping and coolant flow distribution, integrity tests of the fuel, and performance are compared. (C.E.S.)

11457 WYLFA NUCLEAR POWER-STATION. Engineer, 215: 699-700(Apr. 19, 1963).

A brief description of the proposed design for the Wylfa nuclear power station is given. The pressure vessel, reactor core, boilers and circulators, and control and instrumentation are discussed. (C.E.S.)

11458 LATINA NUCLEAR POWER-STATION. Engineer, 215: 798-801(Apr. 26, 1963).

The Latina nuclear power station is described and briefly compared with the Bradwell power station. Civil engineering, shielding, and the control system are discussed. (C.E.S.)

11459 THE NEXT TEN YEARS IN ATOMIC ENERGY DEVELOPMENT. John Cockcroft (United Kingdom Atomic Energy Authority, London). J. Franklin Inst., 277: 1-10 (Jan. 1964).

An attempt is made to forecast the development of nuclear power during the next ten years. (C.E.S.)

11460 CONTROVERSY IN ENGLAND ABOUT THE AGR REACTOR. Yves Mériel. Nature (Paris), No. 3341, 371-4(Sept. 1963). (In French)

The design of AGR is discussed. The fuel and retrieval of statistical information on its performance, the performance of the graphite, the compatibility of reactor materials with CO_2 at high temperatures and pressures, and the control systems are discussed. (R.E.U.)

11461 A REPORT ON FERMI. Octave J. Du Temple. Nucl. News, 7: 28-33(Jan. 1964).

A discussion on the Fermi fast breeder plant held by Detroit Edison Dec. 2 and 3, 1963, is reported. A description of the plant and its capabilities is presented. Development of fuel and sodium-resistant components is summarized, and operating experiences are reported. (R.E.U.)

11462 ATOMNYE ENERGETICHESKIE USTANOVKI. (Atomic Power Plants). A. A. Kanaev. Leningrad, Sudpromgiz, 1961. 428p.

Calculations and descriptions are given of nuclear reactors, fuel assemblies, heat exchangers, and gas and steam turbine designs. Thermal schemes for nuclear electric and propulsion plants are discussed. Data are also given on nuclear fuel reserves, uranium and thorium extraction from ores, and reprocessing of nuclear fuels. (R.V.J.)

11463 SEPARATION OF WATER FROM STEAM IN A BOILING-WATER REACTOR. John F. Wilson, Ronald J. Grenda, and Howard W. Yant (Allis-Chalmers Mfg. Co., Milwaukee). New York, American Society of Mechanical Engineers, 1963, Paper No. 63-WA-250, 7p. $1.00. (CONF-102-30)

From American Society of Mechanical Engineers 1963 Winter Meeting, Philadelphia, Nov. 1963.

Principles and equipment developed for the separation of water from steam in a boiling water reactor are described. Primary separation can be effected by: providing a large surface for natural separation (free-surface separation); forcing the mixture through a device designed to promote separation (mechanical separation); and combining natural and mechanical separation. After primary separation of the steam, steam dryers are used to remove any trace of moisture remaining in the steam. (P.C.H.)

11464 REACTIVITY COEFFICIENT MEASUREMENTS IN FARET. Paul J. Persiani. 16p. (CONF-334-10).

From Conference on Breeding Economics, and Safety in Large Fast Power Reactors, Argonne, Ill., Oct. 1963.

The physics phase of the experimental Fast Reactor Test Facility (FARET) program is discussed. Particular attention is given to the measurement of the fuel temperature coefficient, which is comprised of the expansion and Doppler effect, that can be assigned to a reference power reactor. Zoned loadings are utilized in order to simulate several reference systems. The core is a plutonium-enriched uranium oxide system with U^{238}/Pu^{239} atom ratio of 7/1. (R.E.U.)

11465 REFUELING METHODS FOR LARGE BOILING WATER REACTORS. H. A. Brammer and G. R. Parkos (General Electric Co., San Jose, Calif.). 12p. (CONF-360-11).

From American Nuclear Society Topical Meeting Nuclear Performance Power Reactor Cores, San Francisco, Sept. 1963.

The multiple-batch scatter refueling method is described, and the technical basis for selecting this method is discussed. The operating experience obtained on the Dresden scatter refueled core is summarized. (C.E.S.)

11466 FAILURES IN CRITICAL PIPING SYSTEMS CORRELATED TO NUCLEAR POWER PLANT SERVICE. Helmut Thielsch. 26p. (CONF-102-31).

From American Society of Mechanical Engineers 1963 Winter Meeting, Philadelphia, Nov. 1963.

The failures in critical piping systems for steam power plants, refineries, and chemical plants are reviewed in an attempt to foretell some of the problems to be expected in the future in nuclear power plants. (C.E.S.)

11467 HEALTH PHYSICS EXPERIENCE AT INDIAN POINT STATION. W. F. Nelson (Consolidated Edison Co. of New York, Inc.). 7p. (CONF-187-58)

From American Nuclear Society Meeting, New York, Nov. 1963.

The radiological monitoring program at and in the vicinity of the Indian Point Station is described. (R.E.U.)

11468 FUEL ELEMENT LOCATION IN THE ML-1 REACTOR. H. S. Dreyer. 8p. (CONF-187-59)

From American Nuclear Society Meeting, New York, Nov. 1963.

The procedure for locating failed-fuel elements in the ML-1 reactor is described. (R.E.U.)

11469 EFFECTS OF AXIAL AND RADIAL BLANKET DESIGN ON BREEDING AND ECONOMICS. M. A. Perks and R. M. Lord (United Kingdom Atomic Energy Authority, Risley, Warrington, Lanc, Eng.). 31p. (CONF-334-21)

From Conference on Breeding Economics, and Safety in Large Fast Power Reactors, Argonne, Ill., Oct. 1963.

Variations of axial and radial blanket design are considered separately and in combination for a fixed core configuration. The effects of these variations on derived static parameters of the system are considered and the economic implications of the changed parameters are discussed. A criterion for optimum radial blanket burnup, for maximum economic benefit from blanket in terms of plutonium value, reprocessing cost, and nuclear cross sections is derived. Results are given for a carbide blanket. (R.E.U.)

Process Heat Reactors

11470 THE POSSIBILITY OF USING THE REACTOR COOLED AND MODERATED WITH ORGANIC FLUIDS FOR THE PRODUCTION OF INDUSTRIAL HEAT AT LOW TEMPERATURES. Leonardo Biondi and Lucio Lazzarino (Università, Pisa, Italy). Riv. Ing. Nucl., 1: 177-83(July-Aug. 1963). (In Italian)

The suitability of using the experiences acquired in the field or organic-cooled and -moderated reactors for the study of plants designed for the production of heat for industrial uses and for the desalinization of salt water is discussed. (tr-auth)

Propulsion and Space

11471 (AD-405958) CHEMICAL AND NUCLEAR PROPELLANT MATERIALS. (Defense Documentation Center, Arlington, Va.). June 1963. 17p.

A bibliography is presented which includes 58 references from foreign sources, especially Russian sources. (D.L.C.)

11472 (ASD-TDR-62-424(Vol.1)) DESIGN TECHNIQUES FOR FLIGHT CONTROL SYSTEMS IN NUCLEAR RADIATION ENVIRONMENTS. R. M. Magee, G. M. Brown, S. I. Rosen, and C. D. Taulbee (Bendix Aviation Corp. Bendix Systems Div., Ann Arbor, Mich.). Apr. 1963. Contract AF33(616)-8060. 454p. (AD-405921)

The heating and activation problems of radiation from typical aerospace fission reactor power sources, and the use of self-shielding to minimize radiation damage were investigated for flight control instrumentation. Emphasis is placed on the methodology an instrument designer may use to cope with these problems. (auth)

11473 (NUS-168) ENVIRONMENTAL SAFETY ASPECTS OF NUCLEAR ROCKET FLIGHT OPERATIONS. Quarterly Progress Report (Nuclear Utility Services, Inc., Washington, D. C.). Jan. 1964. Contract SNPC-6. 64p.

The computer program, NURSE-1 (Nuclear Rocket Safety Evaluation), for evaluating the environmental safety aspects of nuclear rocket operations is further developed and refined. Modifications are being incorporated to allow greater flexibility in the program output and to include an increased number of locations for dose calculations. Attempts to improve upon the core fragmentation model to predict size distribution are being made using data from tests with chemical explosives and scale model core mockups of the Kiwi cores. A study was completed to determine the rate of vaporization of an uncooled Rover-type core following engine operation. The study indicated that loss of graphite after reactor shutdown from full power operation under hard vacuum condition will result in partial destruction of the reactor. This destruction can be enhanced by adding reactivity to compensate for loss of coolant flow. The vaporization is probably limited to about 20% of the core graphite. The remainder to the core may be expelled from the reactor vessel. Additional work on the environmental problems associated with premature reentry of core fragments is discussed. (N.W.R.)

11474 (PWAC-385) DESIGN SUMMARY REPORT — LCRE SECONDARY COOLANT PUMP AND SUMP. C. Ferguson, L. K. Knudsen, R. P. Lamers, B. R. Lucas, H. P. Odom, H. V. Marman, and H. Welna (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Jan. 10, 1964. Contract AT(30-1)-2789. 34p.

The pumping unit was designed to circulate 394 gpm of NaK at 700°F with a head rise of 143 feet. The component design features are described in detail. (D.C.W.)

11475 (FTD-TT-63-455) FOUNDATIONS OF CONTEMPORARY AND FUTURE ROCKET PROPULSION SYSTEMS. G. Schubart. A Translation of "Grundlagen der Gegenwaertigen und Zukunftigen Raketenantriebe," published in 1958. 127p.

The principles of present-day (liquid and solid fuel) and future (ion, nuclear, and photon) rocket propulsion systems are discussed. Equations, materials, and designs are considered. (D.C.W.)

11476 ADVANCED PRESSURIZED-WATER REACTOR FOR FIRST GERMAN NUCLEAR ENERGY SHIP. W. Kliefoth. Atomkernenergie, 8: 458-60(Dec. 1963). (In German)

The design of a pressurized-water reactor for use in ship propulsion is described. Inclusion of the heat exchanger in the reactor pressure vessel, operation on a boiling curve, and advantages of the compact design are discussed. Diagrams of the reactor and the ship are included. (M.C.G.)

11477 NUCLEAR POWER IN SPACE. M. C. Gourdine (Curtiss-Wright Corp., Princeton, N. J.). Discovery, 24: No. 7, 14-19(July 1963).

Methods to convert the energy of a nuclear reactor into electric power and electric power into thrust are discussed. The development of SNAP-8 and plasma jet propulsion systems are considered. Mission parameters for planetary landings are also presented. (C.E.S.)

11478 COMBUSTION AND DISINTEGRATION OF ZIRCONIUM HYDRIDE–URANIUM FUEL RODS DURING ATMOSPHERIC RE-ENTRY. F. E. Littman, A. E. Levy-Pascal, and N. A. Tiner (Astropower, Inc., Newport Beach, Calif.). New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-488, 10p, $1.00. (CONF-391-1)

From AIAA Heterogeneous Combustion Conference, Palm Beach, Fla., Dec. 1963.

Studies on ZrH–U fuel rods during re-entry suggest that the probable mode of disintegration is a strong function of their re-entry trajectory, which in turn depends primarily upon the ejection altitude. The disintegration may include: gradual heating of the more or less intact fuel element; continued aerodynamic heating; ejection of the molten material by release of hydrogen or fission products, or me-

chanical failure of the fuel rod as a structure; and further reaction and disintegration of the molten material, resulting, under favorable circumstances, in a complete, explosive disintegration. (P.C.H.)

Research and Test Reactors

11479 (ANL-6797(p.183-92)) NUCLEAR PHYSICS BY THE CHALMERS GROUP AT THE SWEDISH RESEARCH REACTORS. Sam Nilsson, R. Hardell, J. Rohlin, and B. Lundqvist (Chalmers Tekniska Högskola, Göteborg).

Various spectrometers in use with Swedish research reactors are reported. Instruments include bent-crystal diffraction spectrometers, three-crystal pair spectrometers, double-flat-crystal spectrometers, and a permanent-field β-ray spectrograph. (R.E.U.)

11480 (CEA-2344) ETUDE PHYSIQUE DE LA VERSION "CRISTAL DE NEIGE" DE LA PILE EL 3. (Physical Study of the "Snow Flake" Version of the Reactor EL 3). E. Abillon and J. P. Genthon (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 37p.

A systematic study was made of the different thermodynamic and neutronic aspects of various versions of the "snow flake" likely to fulfil the aims which were set out (improvement of the reactivity, of the experimental volume, improvement in the working conditions of EL 3). After this systematic study, a choice was made in principle of one version among the several available (solutions using 8 or 10 pencils-various methods of heat transfer: corrugation, cartridges which may or may not be filled with helium ... etc., variable enrichments ...). The choice is that of a version which can already at the present be considered as feasible, which represents already a notable improvement of the pile and which does not imply the existence of a major problem as far as the possible change-over later to an improved version is concerned. This choice defines a fuel element and a configuration for the core. A detailed recapitulation was made of all the research being carried out for the possible solutions in this particular case. (auth)

11481 (CONF-39-108) A SIMPLE, COMPACT ROD DRIVE USING A STEPPING MOTOR. Edward F. Groh and Charles E. Cohn (Argonne National Lab., Ill.). [196?]. Contract W-31-109-eng-38. 23p.

From American Nuclear Society 9th Annual Meeting, Salt Lake City, June 1963.

A rod drive using a stepping motor was developed for the Argonne Advanced Research Reactor critical experiment. The control rod is suspended from a roller chain which meshes with a sprocket driven by the motor. Rod position is indicated by counting the number of steps. Scram is produced by interrupting the power to the motor windings, thus removing the motor's holding torque. This design offers significant reductions in size and cost compared to existing types. (auth)

11482 (HW-79054(p.47-53)) THE HIGH TEMPERATURE LATTICE TEST REACTOR. W. W. Brown and R. J. Hoch (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Calculations indicate that the temperature coefficient of the reactor could be reduced by a factor of 10 by introducing Gd into the fuel. The resultant reduction of the associated background activity effects would permit the desired observation of reactivity changes as small as a few multiples of 10^{-7}. A possible time-of-flight spectrometer for the reactor was analyzed. (D.C.W.)

11483 (HW-79159) THE MODEL HIGH-TEMPERATURE GAS LOOP TEST SECTION. An Interim Report. D. R. Doman and R. L. Knecht (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 3, 1963. Contract AT(45-1)-1350. 13p.

A test section for the model gas loop has been designed and is being fabricated. This section incorporates many of the general features contemplated for the ATR test section; i.e., the same tubing diameters, possible tube closures, and insulations compatible with attaining and maintaining ultrapure helium in the coolant system. The structural integrity and operating performance of the model loop test section and its components will be determined under even more stringent thermal and pressure conditions than the 1093°C (2000°F) and 280 psig proposed for the ATR itself. (auth)

11484 (HW-79275) DESIGN CRITERIA FOR HELIUM PURIFICATION PLANT FOR THE ATR GAS LOOP. J. H. Hoage, D. C. Kaulitz, and R. E. Westerman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 16, 1963. Contract AT(45-1)-1350. 17p.

A gas purification system was chosen to maintain the requisite helium purity in the ATR gas loop. The general specifications of the system are given. The system is based on the use of CuO + Cu to oxidize H_2 and CO and to remove O_2, a molecular sieve to absorb H_2O and CO_2, and a charcoal bed to absorb N_2, Ar, Xe, and Kr. The instrumentation of the loop for gas analysis is discussed. (D.L.C.)

11485 (HW-79336) REQUIREMENTS AND SELECTION OF INSULATION APPLICABLE TO THE ATR TEST SECTION. D. R. Doman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 25, 1963. Contract AT(45-1)-1350. 14p.

Thermal insulation is needed in the test section of the high-temperature helium-cooled loop to be constructed in the ATR. The requirements of the insulation above the core, in the core, and below the core are listed, and commercially available insulations are compared. Metallic foil insulation most nearly fulfilled the requirements, although metal-clad fibrous insulators and solid ceramic insulators are possible alternatives. (D.L.C.)

11486 (NAA-SR-9009) DEVELOPMENT OF TECHNIQUES FOR INPILE CAPSULE TRANSIENT HEATING EXPERIMENTS. C. F. Bumpus, Jr., M. Silberberg, R. N. Cordy, and W. N. Briggs (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 30, 1964. Contract AT(11-1)-Gen-8. 70p.

A description of the entire complex of experimental apparatus which was utilized for conducting in-pile studies on void formation mechanisms in organic reactor transients is presented. Development of techniques required for the fabrication of portions of the experimental equipment is discussed. Fabrication procedures and techniques for high-temperature and -pressure capsules, fast-response thermocouples, fuel-bearing transient heating sources, and a miniature neutron flux detector are described. A description of the instrumentation system which was assembled for transmitting and recording transient in-pile data from temperature, pressure, and linear displacement transducers is presented. The apparatus and techniques used in the preparation of the in-pile capsule for experimental operation are also described. A major conclusion is that the technology developed for in-pile transient heating experiments, although originally intended for organic coolant studies, is completely suitable for use with other reactor coolants in similar investigations. Adaptation of this technology to liquid metal coolant studies

would entail only a limited extension of the techniques developed in this program. (auth)

11487 (NRL-Memo-1486) SYSTEMS AND TECHNIQUES FOR IN-REACTOR TEMPERATURE CONTROL OF NRL IRRADIATION EXPERIMENTS. J. R. Hawthorne and L. E. Steele (Naval Research Lab., Washington, D. C.). Dec. 1963. 18p.

The irradiation of metallurgical test specimens in the beam port and fuel core facilities of various nuclear test reactors at temperatures ranging from 200 to 800°F has necessitated the design and development of several temperature control systems. Basic systems which have been employed for the irradiation of relatively massive loadings in the various experimental facilities of the Brookhaven Graphite Reactor and the Oak Ridge Low Intensity Test Reactor are described in detail and reference made to inherent system advantages and limitations. (auth)

11488 (ORNL-TM-778) HIGH PRESSURE TEST OF THE HFIR RECIPROCATING ROD SEAL. W. H. Kelley, Jr., and R. M. Hill, Jr. (Oak Ridge National Lab., Tenn.). Oct. 28, 1963. Contract [W-7405-eng-26]. 15p.

Two control rod seal housing designs and several materials combinations of drive rods, seal rings, and seal housings were evaluated for use in the High Flux Isotope Reactor. Test conditions were water at 1000 psig and room temperature. The recommended combination consists of a stainless steel or Stellite-coated rod, Buna "N" or Neoprene Palmetto "O" rings with Micarta backup rings, and a Delrin seal housing. This should give indefinite life provided that misalignment between rod and housing is avoided. (auth)

11489 MODERNIZATION OF THE VVR-S TYPE REACTORS. A. A. At. Energ. (USSR), 15: 439-41(Nov. 1963). (In Russian)

A method was developed for increasing the power level of VVR-S type water-moderated, water-cooled research reactors without major capital expenditure and without requiring major changes in the mechanical features of the core. The improvement involves the replacement of the previously used fuel elements by an octagonal Al-clad fuel assembly, with a heat-exchanging surface increased by a factor of 2.5. The modification resulted in a 4% gain in the available reactivity and in a more efficient utilization of the coolant as more than 90% of the water within the core must pass through the fuel. The assemblies may be placed anywhere in the core, thus facilitating uniform burnup; they can be conveniently used for irradiation tests, as channels or beamholes may be installed in them. The average water temperature in the core is 50°C while the surface temperature of the fuel may reach 90°C. By using a flux trap, thermal fluxes up to 2×10^{14} n/cm^2 may be reached. Operation at 4 Mw requires the installation of new heat exchangers and safety equipment. (TTT)

11490 PROPOSAL FOR USE OF A PHOTONEUTRON START-UP SOURCE FOR THE TRIGA REACTOR (AND USED TYPE). G. Plaschke (Osterreichische Hochschule, Vienna). Atomkernenergie, 8: 432-4(Dec. 1963). (In German)

In order to avoid the necessary annual replacement of expensive polonium-beryllium neutron sources, the possibility of using photoneutrons as a startup source was investigated. After shutting down the TRIGA reactor, the decay rate of the photoneutron density was measured during consecutive 5.5 days. The resulting diagram showed that Ba^{140} (half life 13.8 days) is finally the only hard gamma emitter of the fission products that generates photoneutrons in beryllium. It was calculated that the TRIGA reactor can be started up by these photoneutrons without any difficulty, even if it was out of operation for 2 to 3 months (depending on previous operating conditions). It is only necessary to insert 400 g of beryllium into the middle of the core (central thimble). When the first neutron source of conventional type is consumed it can be replaced by the described photoneutron source. (auth)

11491 AIR ACTIVITY MEASUREMENTS FOR A FUEL ELEMENT RUPTURE IN FRG-1. K. Henning (Schiffbau und Schiffahrt mbH, Reaktorstation Geesthacht, Ger.). Atomkernenergie, 8: 444-7(Dec. 1963). (In German)

The aerosol activity in the reactor hall of the swimming pool reactor at Geesthacht was measured when a small fuel element rupture occurred. With these aerosol activity measurements it was possible to find out which of the 35 fuel elements had the defect. The activity on the filters was determined to be mainly Cs^{138}, Cs^{139}, Rb^{88}, and Rb^{89}. A multichannel analysis was used and the half life of the activity determined. The MPC-values (maximum permissible concentration) of these isotopes were calculated. (auth)

11492 ON THE DISTRIBUTION OF SOME FISSION PRODUCTS BETWEEN CORE AND RECOMBINER OF THE L54 REACTOR. P. R. Gorla, E. Lazzarini, V. Sangiust (CESNEF, Milan). Energie Nucl. (Milan), 10: 679-84 (Dec. 1963).

The fission-product distribution between core and recombiner of L54 water-boiler reactor was investigated. Preliminary results for Sr^{89}, Sr^{90}, Cs^{137}, and Ba^{140} activities in fuel solution and recombiner water are reported and discussed. (auth)

11493 THE REACTOR ARGONAUT-AGIP NUCLEARE (RB-2) OF MONTECUCCOLINO. F. Benedetti, G. Brighenti, P. L. Chiodi, G. Guenzi, and A. Lovati (SNAN, San Donato Milanese, Milan). Energie Nucl. (Milan), 10: 685-92(Dec. 1963). (In Italian)

On May 28th, 1963, the Reactor Argonaut-Agip Nucleare (RB-2) went critical for the first time. The plant, built at the Laboratorio di Montecuccolino of the University of Bologna (Italy), for research and training in the field of reactor physics is described. (auth)

11494 USE OF SORIN'S POOL-TYPE REACTOR "AVOGADRO," RS-1. A. Rossi and H. Walther (SORIN Centro Richerche Nucleari, Saluggia, Italy). Res. Reactor J., 4: 1-8(1963).

The uses of the 2-Mw pool-type research reactor Avogadro RS-1 are reviewed. Research programs are summarized. 43 references. (R.E.U.)

11495 THE PTR GOES TO COLLEGE. B. Francis Rolston (Manhattan Coll., New York). Res. Reactor J., 4: 9-15(1963).

The installation of the PTR core and control-rod drives at Manhattan College is reported. The name for the facility is the Manhattan College Zero Power Reactor (ZPR), and the reactor will be used as an educational tool. (R.E.U.)

11496 PRODUCING SHORT-LIFE RADIOISOTOPES IN RESEARCH REACTORS. P. C. Aebersold (U. S. Atomic Energy Commission, Washington, D. C.) and A. F. Rupp. Res. Reactor J., 4: 16-22(1963).

The role of small research reactors in isotope production is reviewed. Radioisotope production and fast processing at ORNL is discussed. (R.E.U.)

11497 THE NUCLEAR NOISE RESEARCH PROGRAM AT THE UNIVERSITY OF FLORIDA. Robert E. Uhrig (Univ. of Florida, Gainesville). 57p. (CONF-332-4)

From Symposium on Noise Analysis in Nuclear Systems, Gainesville, Fla., Nov. 1963.

The use of noise techniques to determine the source transfer function of a subcritical assembly is discussed. A neutron generator in conjunction with a "thermalizer box" was used to produce a sinusoidal variation in thermal neutron source intensity. The method was also used to measure the power spectral density of the electrical signal coming from a neutron detector in the assembly, from which the amplitude of the transfer function could be determined. Experiments were carried out on the UFTR critical reactor with random reactivity variations in an attempt to verify a two-region mathematical model. The method used was to measure the cross spectral density between the outputs of two ionization chambers located adjacent to the two regions of the reactor while a disturbance was being introduced by a random reactivity generator. The impulse response of subcritical systems was studied. Future research at University of Florida is discussed. (R.E.U.)

WASTE DISPOSAL AND PROCESSING

Refer also to abstract 11375.

11498 (AD-404279) AN EVAPORATOR-TYPE RADIOACTIVE LIQUID WASTE CONCENTRATOR WITH DISPOSABLE VESSEL. Eliezer Rubin, Arye Reisser, and Algird Karalis (Radiation Applications Inc., Long Island City, N. Y.). Mar. 5, 1963. Contract DA18-108-CML-7196. 69p.

Detailed design specifications and operating instructions are presented for a prototype evaporation unit with disposable vessel for concentrating radioactive liquid wastes. The design is based on the use of drums as evaporation vessels so adapted that the feed inlet, vapor outlet, steam connections, and liquid level control are detachable permitting the drums to be detached from the rest of the equipment and shipped for land disposal. The complete evaporation unit is portable, automatically controlled, and has operating requirements for a supply of 80 to 150 psi steam for the evaporator, cooling water for the condenser, and electricity for operation of the pumps and controls. (auth)

11499 (AERE-R-4493) THE EXTRACTION AND PURIFICATION OF STRONTIUM FROM FISSION-PRODUCT SOLUTIONS. H. J. de Nordwall and G. J. Gittens (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1964. 26p.

An appraisal of the conditions required for the precipitation of alkaline earth nitrates from fission product solutions was made. The theoretical predictions were experimentally confirmed. A scheme involving precipitation at 55°C from 16N nitric acid and leaching of the strontium from the precipitate with 5N nitric acid at 35° is suggested. The product is a mixture of strontium and barium nitrates essentially free from other elements. (auth)

11500 (JAERI-1048) TEST OPERATION AND COST ESTIMATION ON THE RADIOACTIVE WASTE TREATMENT PLANT AT JAERI. Sadahiro Sakata, Masukuni F. Ito, and Nobu Mitsuishi (Japan Atomic Energy Research Inst., Tokyo). June 1963. 55p. (In Japanese)

Performance data on test operations conducted through April 1960 and treatment cost estimates concerning the Radioactive Waste Treatment Plant at JAERI (cf. JAERI-1021) are given. Test operations were first conducted with nonradioactive materials and then with real radioactive wastes from JAERI. The flocculation and ion exchange unit, evaporation unit, and incineration unit were examined. The performance data showed that the facilities fulfilled their specifications and functions expected from the initial planning. Considering that the plant is the first of the kind in Japan, some peculiarities and operational troubles were also pointed out from the view point of radioactive waste treatment. Brief cost estimates on each facility have been carried out with two purposes as follows: (1) to find out the optimum natures of wastes for each treatment process and, consequently, to serve as a reference of the selection of a suitable treatment process for a specified waste; (2) to suggest practical ways for realization of more economical waste treatment. For the liquid treatment, it is shown that solid content is one of the most important indices in this system. Some reasonable combinations of various ion exchanges and evaporations were examined to clarify their optimum regions in connection with solid content. For the solid processing, incineration is more favorable than direct storage. (auth)

11501 A METEOROLOGICALLY OPERATED STACK CONTROL SYSTEM. Gerald C. Gill and Eugene W. Bierly (Univ. of Michigan, Ann Arbor). J. Appl. Meteorol., 2: 431-9(Aug. 1963).

The standard deviation of wind direction and the mean wind speed were incorporated into a system for controlling the release of radioactive gaseous wastes from the 200-ft stack of the Enrico Fermi Atomic Power Plant. The meteorological sensor used in the system is a Bendix-Friez Aerovane, located on top of a 100-ft meteorological tower near the stack. Data from the Aerovane are processed by a small analog computer whose outputs are displayed on the control board of the reactor control room and a recorded on strip chart recorders. The display enables the reactor operator to know whether the stack is open to the atmosphere or whether the gases are being stored in containment tanks. Averaging times of the meteorological variables may be switched to 3, 6, 12, or 24 minute periods. A discussion of several representative records from the computer and the Aerovane, pointing out some of the interesting features of this system, is presented. (auth)

11502 STATUS OF RADIOACTIVE LIQUID WASTE MANAGEMENT IN THE UNITED STATES. Walter G. Belter and Harold Bernard (U. S. Atomic Energy Commission, Washington, D. C.). J. Water Pollution Control Federation, 35: 168-85(Feb. 1963).

Current radioactive waste disposal practices illustrate a high degree of safety throughout the various phases of the fuel cycle. The Atomic Energy Commission also supports a vigorous research and development program in the many and varied aspects of waste management. The research and development projects, besides attempting to solve particular problems at operating sites, also endeavor to develop performance criteria which can be utilized to determine future radioactive waste management practices. (auth)

11503 RADIOACTIVE CONTAMINATION OF THE SEA. PROBLEMS IN THE DISPOSAL OF RADIOACTIVE WASTES IN THE SEA. Yasuo Miyake (Tokyo Univ. of Education). Shizen, 18: No. 8, 22-7(Aug. 1963). (In Japanese)

The present state of radioactive contamination of the sea around Japan is described. The concentrations of Sr^{90} and Cs^{137} in the surface waters in 1957 to 1961 are given. These data are compared with those obtained for coastal waters off California, U. S. A. The vertical distribution of these nuclides in the sea is discussed. The disposal of radioactive wastes in the sea requires studies on an economical and strong package of wastes and ecology of marine organisms. Wastes from nuclear-powered ships pose new problems. Behaviors of radioactive substances in the sea are described. The behaviors depend on the following factors: layers in the sea, transport by ocean currents and tidal currents, horizontal diffusion, vertical diffusion, stagnation of coastal water, upwelling, discontinuity among water masses, accumulation of radioactive substances in organisms, transport by organisms, chemical and physical separation, different chemical forms of radioactive substances, ion exchange and adsorption, and changes after sedimentation. If disposal in the sea is necessary, it is important that the disposal must be effected without impairing marine resources. (Nucl. Sci. Abstr. Japan, Vol. 2, No. 4)

11504 SUPPRESSION OF RUTHENIUM VOLATILIZATION IN EVAPORATION AND CALCINATION OF RADIOACTIVE WASTE SOLUTION. W. E. Clark and H. W. Godbee (to U. S. Atomic Energy Commission). U. S. Patent 3,120,493. Feb. 4, 1964.

A method of suppressing ruthenium volatilization in the evaporation and calcination of nitric acid fission-product solutions obtained in the reprocessing of irradiated reactor fuels is described. Phosphite or hypophosphite ions are provided in the solution to prevent volatilization of ruthenium and thus to decrease the radioactive contamination of off-gas equipment. These ions are converted to phosphate, which lowers the melting point of the resulting solids and enhances the formation of a glass-like product. Fission-product waste solutions are converted by this process to a stable, insoluble solid form suitable for long-term storage. See also NSA 17: 17618. (AEC)

11505 PROCESS FOR RECOVERY OF STRONTIUM VALUES FROM FISSION PRODUCT WASTE SOLUTIONS. D. E. Hroner and R. P. Wischow (to U. S. Atomic Energy Commission). U. S. Patent 3,122,414. Feb. 25, 1964.

An improvement in the recovery of strontium-90 from fission-product waste solutions by solvent extraction with an organic solvent containing di(2-ethylhexyl)phosphoric acid is reported. Iron values, normally present as a corrosion product in fission-product solutions, are complexed by addition of tartrate ions to control iron interference with extraction of strontium. The complexed fission-product solution is first contacted with the organic phase to extract strontium and rare-earth fission products. Strontium is then separated from the rare earths by stripping and extracting the rare earths with the same organic phase at a low pH. (AEC)

GENERAL AND MISCELLANEOUS

11506 (AD-405962) WEAPONS. (Defense Documentation Center, Arlington, Va.). June 1963. 28p.

A bibliography of 106 references is presented on hazards of atomic explosions, radiological warfare and defense, and biological warfare and defense. Most of the references are from foreign sources, particularly Russian ones. (D.L.C.)

11507 (AD-427700) TRANSACTIONS OF THE EIGHTH SYMPOSIUM ON BALLISTIC MISSILE AND SPACE TECHNOLOGY, HELD AT THE UNITED STATES NAVAL TRAINING CENTER, SAN DIEGO, CALIFORNIA, OCTOBER 16-18, 1963. VOLUME I. KEYNOTE ADDRESS, ADVANCED PROPULSION TECHNOLOGY, VEHICLE DESIGN, RELIABILITY AND PILOT SAFETY, AND MATERIALS FOR THERMAL PROTECTION. (Aerospace Corp., El Segundo, Calif.). 400p.

Fourteen papers are presented on the teleology of military research and development, advanced propulsion technology, launch vehicle dynamics, procurement of electronic parts, malfunction detection in Titan III and other vehicles, and materials for thermal protection. Separate abstracts were prepared for three of the papers dealing with materials for thermal protection. (D.L.C.)

For abstracts of individual papers see: 10494, 10519, and 10520.

11508 (IDO-16917) MATERIALS TESTING REACTOR-ENGINEERING TEST REACTOR TECHNICAL BRANCHES. Quarterly Report, April 1–June 30, 1963. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Nov. 18, 1963. Contract AT(10-1)-205. 49p.

Distortion and cracking of portions of the MTR Be reflector are reported. Preliminary metallurgical and gas analyses on fracture chips indicate that some of the fractures may have occurred at exposures much lower than 10^{22} nvt (>1 Mev). The resonance integrals of mixtures of Au and indium oxide as calculated by a modified ZUT code were compared with the integrals calculated with the RBU Monte Carlo program. Although there were some discrepancies between the results of the two methods, both methods showed some interaction between the prominent Au and In resonances. The geometry routine, zone construction subroutine, and particle search subroutine were programed and checked for the Phillips general purpose Monte Carlo program. Flow charts are being written for the collision routine and the pre-Monte Carlo routine. An unsuccessful attempt was made to observe gamma rays emitted in the decay of Pt^{200}. The energies and intensities of the gamma rays from Au^{200} were remeasured. Statistical techniques were employed to determine those angles and relative frequencies of measurements which will, for a given total number of observations, give the smallest variances for the directional-correlation coefficients in correlation functions which contain P_6 (cos θ) and P_8 (cos θ) terms. (auth)

11509 (IDO-16927) PREPARING OPERATING MANUALS FOR EXPERIMENTAL FACILITIES AT TRA. Standard Practices Guide. D. T. Neill (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Nov. 8, 1963. Contract AT(10-1)-205. 20p.

Includes Appendices A through D.

The desired format and contents of operating manuals to be used at the Test Reactor Area (TRA) and the preferred organization of procedures and other material are described. The technique for keeping the manuals up to date is explained. Examples of selected portions of existing manuals are presented in appendices. (auth)

11510 (JAERI-7027) ANNUAL REPORT OF THE JAPAN ATOMIC ENERGY RESEARCH INSTITUTE FOR FISCAL 1962, APRIL 1962–MARCH 1963. (Japan Atomic Energy Research Inst., Tokyo). Oct. 1963. 136p. (In Japanese)

The report consists of the following five Chapters: General statements, Progress of research activities, Construction and maintenance of facilities, Service works and external works, and General affairs and administration. In the first Chapter are mentioned as the features of the fiscal year the start of construction of the Takasaki Research Establishment, reloading of the JRR-2 with 90% enriched uranium, criticality of the JRR-3 (a Japan-made reactor), start of distribution of the JAERI produced radioisotopes, start of the development program of domestic power reactors, and advancement of various international cooperations. Detailed descriptions are made of the state of progress and the results obtained in the respective fields of research (physics, chemistry, reactor physics, reactor safety, fuels and materials, reactor instrumentation and control, heat transfer and reactor components, fuel reprocessing, production studies of radioisotopes, radiation chemistry, health physics), construction progressed as planned on the JPDR, JRR-4, the hot cave for engineering studies, etc., while the facilities already completed were used as previously both by the Institute personnel and by outside people. It is stated that the cooperation with outside institutions etc. had become more active. (D.L.C.)

11511 (NAA-SR-8881) EMF MEASUREMENTS IN MOLTEN DIVALENT METAL–METAL HALIDE SOLUTIONS. L. E. Topol (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 30, 1964. Contract AT(11-1)-Gen-8. 15p.

Potentiometric studies on concentration cells of the type C, $M(N_1)$, $MX_2(1-N_1)$ || $MX_2(1-N_2)$, $M(N_2)$, C, where M represents Hg, Cd, Pb, and Zn, MX_2 the halide, and N denotes the metal mole fraction, were made at various temperatures. Slopes of plots of the log metal concentration vs emf yielded apparent Nernst n values of 2 for Hg–$HgCl_2$ at 300° and for Cd–$CdCl_2$ at 580°. For Pb–PbI_2 apparent Nernst n values of about 2.2 to 2.3 were found at 585 and 693°; for Pb–$PbCl_2$ the low metal solubility made detection of an n value difficult but a value of 2 appeared probable. No constant emf's were obtained in Zn–$ZnCl_2$ melts at 658 and 695°. The above n values of 2 indicate a two-electron reaction at the electrode and are consistent with the existence of metal atoms M or cation dimers M_2^{2+}. No evidence for the monomer ion M^+ was observed. (auth)

11512 (NARF-63-9p) NARF FINAL PROGRESS REPORT, OCTOBER 1, 1962 THROUGH SEPTEMBER 30, 1963. (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Contract AF33(657)-7201. 250p. (FZK-9-191; AD-426156)

Development and fabrication of an exhaust-gas sampler for the TORY IIC were completed except for tests of tip durability in the exhaust jet. Further durability tests are recommended. Radiation considerations in design of Orion-

type vehicles are discussed. Radioinduced vehicle and fuel heating is examined along with radiation streaming in ducts. Fabrication of thermal transducers, an argon monitor, a TV system for reactor operations, and shielding instrumentation is reported. Aspects of installation and use of an acoustic facility in the Ground Shield Test Reactor (GTR) are discussed. Data are tabulated on radiation damage in Si and Ge transistors according to base material and typical use to which each may be put. Results of constant-temperature irradiation of three thermistor types are reported. The tests were conducted to determine the effects of total dose at constant temperature. The effects of light, gamma irradiation and temperature on the electric conductivity of polyethylene are reported. Radiation effects data are included on fluid and solid lubricants. Other radiation effects data are included on elastomeric and plastic materials such as polyethylene, acetal resins, polyvinyl carbazole, and polycarbonate. Radioinduced reactions of polyethylenes were studied, and data are presented on gas liberation, temperature dependence of trans-vinylene absorbance, and chain scission and linking. Information obtained in studies of resonances in free-radical intermediates of gamma-irradiated hydrocarbons and thermoluminescence of 1-dodecyne is included. In the study of low-energy subexcitation electrons in hydrocarbon gases, improvement of detection capabilities is reported along with data accumulation in this area. Data are included on He, methane, ethane, and propane excitation by energetic electrons. Data and conclusions resulting from an evaluation of a proposal for improving the accuracy of neutron spectral measurements using foils are given. Response data on several neutron detectors are included. Developmental work on In and U foils is reported. Radiation effects on N_2O at liquid N_2 temperature are discussed. Work on control rod optimization resulted in development of a suitable alloy for use in the GTR. Results of analytical studies directed toward shielding properties of active and passive materials are discussed. Modification of the Aerospace Shield Test Reactor (ASTR) for 10-Mw operation is reported along with GTR modification and maintenance. A list of reports issued under NARF-63 statement of work is included. (J.R.D.)

11513 (NP-13539) COLLECTED PAPERS OF THE DIELECTRICS IN SPACE SYMPOSIUM, JUNE 25-26, 1963. (Westinghouse Electric Corp. Research Labs., Pittsburgh). 87p.

Separate abstracts were prepared for six of the thirteen papers included. One other paper on inorganic motor insulation was previously abstracted in NSA. The remaining papers are on dielectric properties of the space environment, gas discharges, polymers, other dielectric properties, radiation-induced conductivity in dielectrics, and solar energy conversion using dielectric films. (D.C.W.)

For abstracts of individual papers see: 10538, 10575, 10576, 10577, 10578, and 11303.

11514 (ORNL-3415) THE JOINT NATIONAL INSTITUTES OF HEALTH–ATOMIC ENERGY COMMISSION ZONAL GENTRIFUGE DEVELOPMENT PROGRAM, SEMIANNUAL REPORT, JULY 1–DECEMBER 21, 1962. N. G. Anderson (Oak Ridge National Lab., Tenn.). Mar. 4, 1963. Contract W-7405-eng-26. 96p.

Development work done on zonal centrifuge systems to develop new methods for isolating virus particles associated with cancerous cells and tissues is described. Three classes of rotor systems capable of separating particles ranging in size from whole animal or plant cells to protein or nucleic acid molecules on the basis of either sedimentation rate or density alone were developed. Experiments with phage particles indicate the feasibility of large-scale virus isolation by continuous-flow centrifugation, followed by isopycnic banding in cesium chloride and velocity sedimentation in sucrose with all steps being carried out sequentially in the same rotor. Zonal rotors using the reorienting gradient principle for molecular separations were tested to 141,000 rpm (310,000 × g at R_{max}). (auth)

11515 (ORNL-3502) THE JOINT NATIONAL INSTITUTES OF HEALTH–ATOMIC ENERGY COMMISSION ZONAL CENTRIFUGE DEVELOPMENT PROGRAM, SEMIANNUAL REPORT, JANUARY 1–JUNE 30, 1963. N. G. Anderson (Oak Ridge National Lab., Tenn.). Oct. 11, 1963. Contract W-7405-eng-26. 102p.

Development work on methods of particle separation is described. The central effort was to develop zonal centrifuge systems for the separation of cells and subcellular particles, including viruses, and biocolloids, including proteins and nuclec acids. Three types of low-speed (A series) rotors were developed. The stability problems which limited the B-II rotor to approximately 25,000 rpm are being solved, and operation at 40,000 rpm (90,800 × g) was obtained with a new experimental upper damping bearing. In addition, high-speed zonal ultracentrifuges were designed and tested [C-I to C-V, 141,000 rpm (310,000 × g) to 40,000 rpm (91,000 × g)]. A prototype of an ultrahigh-speed centrifugal system (D series capable of 1.2 million × g) was tested to 300,000 rpm. Theoretical studies were undertaken on: rotor stability and design, including fabrication; metallurgical studies, including stress analysis and corrosion resistance; instrumentation and controls; chemistry of cesium chloride for reprocessing; electron microscopy; mathematical analyses of flow rates for continuous centrifugation; containment and sterilization; and data reduction. Two types of adenovirus and respiratory syncytial virus were separated and concentrated, using the B- and C-series rotors. The biological implications of these centrifuge systems extend from determining the distribution of drugs or other materials in cells to the separating of viruses from tumors. Also under study is the possibility of using zonal centrifuges for vaccine production. Ancillary studies being carried out include pressure filtration and dialysis, ultrahigh-pressure chromatography, flame ionization analysis (capable of resolving 10^{-12} g of carbon), and a cell synchronizer capable of continuously growing 10 to 60 liters of cells. Other biological studies reported include: a method for cesium chloride banding, using angle-head rotors; cell synchronization studies; sugar analyzer development; automated nucleotide studies; separation of radionuclides from river water; distribution of particulates in Escherichia coli; and protein synthesis of ribosomes from E. coli and rat liver thymus. The biological studies undertaken in parallel with the developmental effort are the isolation of virus particles from complex mixtures, examination of changes in cell composition which follow virus infection, and alterations in cell composition during the cell cycle. (auth)

11516 (SC-4959(M)) VISUAL AIDS FOR MANUFACTURING PERSONNEL. Joseph Crompton (Sandia Lab., Albuquerque, N. Mex.). Feb. 1964. Contract [AT(29-2)-789]. 15p.

Visual aids reduce the problem of organizing complex engineering requirements at factory and field work stations. This report presents the simplified techniques used at Sandia Corporation in developing visual aids for weapon

rebuild operations. However, these simplified techniques also have broader applications and can be used wherever complicated relationships must be translated into shop language. (auth)

11517 (SC-DC-64-278) ULTRA-PURE BARIUM TITANATE MATERIALS DEVELOPMENT FOR EXPLOSIVE-TO-ELECTRICAL TRANSDUCERS. Report No. 17, April 1, 1961 through March 31, 1962. E. C. Henry, A. V. Illyn, and W. Tantraporn (General Electric Co. Electronics Lab., Syracuse, N. Y.). Contract AT(29-1)-789. 76p.

This is the final report on an investigation of ultra-pure barium titanate for ceramic explosive-to-electrical transducers. Major attention was given to the preparation of transducer materials with increased dielectric strength. Procedures were determined and reported for producing translucent, uniform-textured test units of such material. One of the advantages of using purified barium titanyl oxalate is that it may be produced with exceptionally fine particle size. To preserve these small particles and to provide a soft calcine (with decreased tendency to become contaminated during further processing), and yet to assume complete conversion of the titanyl oxalate to the titanate, a low-temperature calcination is recommended. Procedures are detailed for determining the optimum calcination and firing conditions for producing the microstructure leading to the highest dielectric strength. This microstructure is one of fine crystallite size, having reduced values of d_{33}. The problem remains of increasing the crystallite size, and hence the d_{33}, without sacrifice of dielectric strength. A method is proposed of reproducibly preparing test units of increased density and larger crystallites, that is, of increasing both the piezoelectric activity and the dielectric strength. (auth)

11518 (SC-DC-64-291) INVESTIGATION OF FUSED ORGANIC SALT CELLS (thesis). Final Report. Richard A. Wallace (Brooklyn. Polytechnic Inst.). Sept. 7, 1962. For Sandia Corp., Albuquerque, N. Mex. Contract AT (29-1)-789. 161p.

This investigation was initiated to study the feasibility of organic salts as molten electrolytes in low-temperature (< 300°C) fused salt cells capable of delivering electrical energy. Two such salts were investigated: methylpyridinium bromide and KCl–acetamide. Methylpyridinium bromide was found to be a relatively strong electrolyte but did not furnish appreciable electrical energy when tested with various electrochemical couples, owing to reactions with cathodic depolarizer materials. On the other hand, saturated KCl–acetamide satisfied all requirements for use as a cell electrolyte. The physical and electrochemical properties of the KCl–acetamide system were determined. The Zn/KCl–acetamide/AgCl, Ag cell was studied in detail. The chemical reactions occurring at the individual electrodes and other electrochemical properties of the cell were determined. (D.L.C.)

11519 (SCL-TM-64-1) ROOM-TEMPERATURE-CURED LAMINATING RESIN SYSTEMS. G. R. Dunbar (Sandia Corp. Livermore Lab., Livermore, Calif.). Feb. 1964. Contract AT(29-1)-789. 12p.

Laminates were fabricated to test various room-temperature-cured (RTC) resin systems that were considered potentially usable in filament-winding applications. The mechanical properties of these laminates were tested to determine the degree of strength retention at elevated temperatures. As expected, strength retention was significantly less for those RTC resin laminates tested than is normally found with typical laminates using resin systems cured at elevated temperatures. (auth)

11520 (TID-3721) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE ISSUED OR IN PROGRESS DURING THE PERIOD DECEMBER 1963–JANUARY 1964. (Division of Technical Information Extension, AEC). 18p.

A list of 119 bibliographies issued or in preparation is presented, arranged according to the issuing organization. Subject, author, and report number indexes are included. (D.L.C.)

11521 (TID-17992) CALCIUM TRANSPORT IN TOMATO ROOTS. William Lopushinsky (Duke Univ., Durham, N. C.). Feb. 6, 1963. Contract AT(40-1)-1827. 11p.

When whole root systems of detopped tomato plants were immersed in nutrient solution labeled with Ca^{45}, the concentration of Ca^{45} in the xylem sap exceeded the Ca^{45} concentration of the nutrient solution. Electrophoretic examination of the xylem sap showed that Ca was present in a free ionic form. The results constitute evidence for active transport of Ca ions into the root xylem of tomato plants. (auth)

11522 (TID-19926) GEOLOGIC ASPECTS OF THORIUM RECOVERY FROM COMMON ROCKS. Quarterly Progress Report, June 1, 1963–August 31, 1963. (Rice Univ., Houston, Tex.). For Oak Ridge National Lab., Tenn. Contract [W-7405-eng-26], Subcontract 1491. 7p.

The detection and measurement of thorium, uranium, and potassium content in New Hampshire's Conway granites are summarized. (N.W.R.)

11523 (TID-19927) GEOLOGIC ASPECTS OF THORIUM RECOVERY FROM COMMON ROCKS. Quarterly Progress Report, September 1, 1963–November 30, 1963. (Rice Univ., Houston, Tex.). For Oak Ridge National Lab., Tenn. Contract [W-7405-eng-26], Subcontract 1491. 14p.

The content of thorium, uranium, and potassium in New Hampshire's Binary and Conway granites, Arkansas' Atoka and Jackfork sandstone, and Oregon's Tyee and Umpqua sandstone is analyzed. A special study on the effects of weathering on uranium and thorium in the Conway granites is reported. Results show that weathering processes have leached and isotopically fractionated uranium to a depth of 30 to 40 feet below the surface, and leaching of uranium has occurred at greater depths in the vicinity of joints. (N.W.R.)

11524 (TID-19937) AN ECOLOGICAL STUDY OF SELECTED NUTRIENTS IN COMMON MULE DEER BROWSE PLANTS. Henry L. Short, Donald R. Dietz, and Elmer E. Remmenga (Colorado Cooperative Wildlife Research Unit, Fort Collins; Forest Service, Rapid City, S. Dak.; and Colorado State Univ., Fort Collins). 1962. Contract AT(11-1)-898. 33p.

Nine plant species, believed to be important to mule deer (Odocoileus hemionus) on the Cache la Poudre Range of Colorado, were collected from 5 study areas which varied in altitude from 6,400 to 10,300 ft. Eleven chemical components were analyzed for each of the 77 plant samples. The chemical indices were correlated with 9 environmental measurements determined for each of the 5 study areas. Nutrient value of the plants during the four seasons is discussed. (C.H.)

11525 (TID-20030) INFRARED STUDIES OF CHEMISORBED MOLECULES. Progress Report, August 1, 1962–August 15, 1963. Kentucky Research Foundation No. 3434. Hartley C. Eckstrom (Kentucky. Univ.,

Lexington. Kentucky Research Foundation). Contract AT(40-1)-2948. 5p.

Progress is reported on a study of the infrared spectra of rhodium containing chemisorbed hydrogen, deuterium, and carbon. A total of 19 bands is reported in the fundamental region from 2193 to 1489 cm^{-1} for rhodium containing chemisorbed hydrogen. The number of bands in the overtone and summation region is discussed. The spectra for deuterium over rhodium films are being looked for in the region of 1550 to 1480 cm^{-1}. Carbon sorption is studied with respect to decomposition of ethylene. (N.W.R.)

11526 (TID-20051) THE INFLUENCE OF ANNEALING ON THE ELECTRICAL PROPERTIES OF COLD-WORKED Ag–Pd ALLOYS. Wei-Kong Chen and M. E. Nicholson (Minnesota Univ., Minneapolis). [1962]. Contract AT(11-1)-1009. 35p.

The influence of annealing on the electric resistivity and Hall constant of cold worked silver–palladium alloys was determined. In addition, a study was made of the effect of cold working on the magnetic susceptibility and thermoelectric power of these alloys. Two processes occur during annealing. One causes an increase in resistivity. This appears to be due to a decrease in the number of conduction electrons as indicated by the Hall constant becoming more negative. This is attributed to the re-establishment of short-range order which is destroyed by cold working. The other process causes a decrease in resistivity. This is probably due to the elimination of lattice defects, principally vacancies, which results in a reduction of electron scattering. These opposing processes are influenced to different degrees by the amount of prior plastic deformation and the annealing temperature. The magnetic susceptibility of a 9.5% and of a 41.8% Pd alloy is not appreciably altered by cold work. These alloys are diamagnetic and exhibit no change in magnetic susceptibility between –196°C and room temperature. The relative change in absolute thermoelectric power produced by cold working deviates negatively for all compositions from that of pure silver. These observations support the hypothesis that short-range order exists in the annealed alloys and that it is destroyed by cold working. The effect of short-range order on resistivity, Hall constant, and thermoelectric power is discussed in terms of both Gibson's theory and the superzone concept. (auth)

11527 (TID-20057) EFFECT OF PLASTIC DEFORMATION ON THE RESISTIVITY AND HALL CONSTANT OF SILVER–PALLADIUM ALLOYS. R. W. Westerlund (Aluminum Co. of America. Alcoa Research Labs., New Kensington, Penna.) and M. E. Nicholson (Minnesota. Univ., Minneapolis). [1962]. Contract AT(11-1)-1009. 25p.

The influence of cold working on Hall constant and resistivity was measured for five silver–palladium alloys containing from 10 to 55% Pd. The measurement of electric resistivity, which confirmed the existence of a resistance minimum, was extended to true strains of 2.25. The Hall constant changes as much as 20% for a 30% Pd alloy. The increase in effective number of electrons indicated by the change in Hall constant causes the anomalous resistivity in these alloys. The magnitude of the change in Hall constant and the decreasing rate of change as a function of cold working suggest the behavior results from the disordering of a short-range order configuration during cold work. (auth)

11528 (TID-20062) METAL COMPLEXES OF SYDNONES, SYDNONE IMINES, AND THEIR INFRARED SPECTRA (thesis). Theresa Lim Mao (Fordham Univ., New York). 1963. Contract AT(30-1)-906. 58p.

This study was undertaken to investigate the ability of sydnones and sydnone imines to form complexes and to establish, if possible, the site and type of bonds formed. By solid-solid interaction, eighteen sydnone-ferric chloride complexes and the stannic salt of N-n-butylsydnone imine hydrochloride were synthesized. From collating the experimental data of these two meso-ionic compounds and their complexes and salts, the following conclusions have been reached. (1) The compounds formed between sydnones and $AlCl_3$, $FeCl_3$, $SbCl_5$, $SnCl_4$, $TeCl_2$, $TiCl_4$, and $ZnCl_2$ by solid-solid interaction are charge-transfer complexes and the bonding occurs with the carbonyl group. (2) From the type of the complex and the site of the bonding, the most electronegative position of the sydnone ring appears to be the exocyclic oxygen atom, in support of the molecular orbital calculations. (3) The compounds formed by solid-solid interaction of sydnone imines and H_2PtCl_6, H_2SbCl_7, and H_2SnCl_6 are salts. (4) A comparison between the spectra of sydnones, sydnone imine hydrochlorides, and their complexes and salts have led to a more complete set of new assignments than was previously possible. (5) The absorption frequencies which characterize a sydnone or sydnone imine ring have been found. (6) Definite assignments for imine hydrochlorides are given for the first time. (auth)

11529 (TID-20066) THE THERMAL CONDUCTIVITY OF INORGANIC MELTS. Annual Report. (Carnegie Inst. of Tech., Pittsburgh. Metals Research Lab.). Jan. 21, 1964. Contract AT(30-1)-2360. 16p.

A research program is being conducted on the mechanism of thermal transport in fused sulfides and other semiconductors. The expression of the thermal conductivity of a liquid semiconductor as a sum of contributions of independent transport mechanisms is considered briefly. The work during this period was concentrated on the development of new apparatus and experimental methods. Results of corrosion and screening tests are tabulated. (D.L.C.)

11530 (TID-20070) STUDIES ON THE PRODUCTIVITY OF VASCULAR HYDROPHYTES AND THEIR ROLE IN MINERAL CYCLING IN AQUATIC ECOSYSTEMS. Progress Report Covering the Period January 1, 1963–December 31, 1963. Richard T. Hartman (Pittsburgh. Univ.). Jan. 15, 1964. Contract AT(30-1)-3018. 42p.

Progress is reported in studies of mineral cycling in aquatic ecosystems in western Pennsylvania. Ecological data, data on the productivity of vascular hydrophytes, and results of studies on the uptake and translocation of P^{32} and Fe^{59} by vascular hydrophytes are presented. (C.H.)

11531 (TID-20073) THE KINETICS OF CRYSTALLIZATION OF POLYPROPYLENE FRACTIONS. [PART] II. E. Meinecke (Massachusetts. Univ., Amherst. Polymer Research Inst.). [1963]. Contract [AT(30-1)-2736]. 33p.

Isothermal crystallization rate data for polypropylene films are obtained by a rapid scanning x-ray-diffraction technique. These are compared with previously obtained data on similar samples of the same polymer by microscopic observation of spherulite nucleation and growth rates. The degree of crystallinity is found to increase more slowly than the weight fraction of the sample filled with spherulites, indicating that all of the crystallization does not occur at the growing spherulite surface. A mechanism for this secondary crystallization process occurring within the spherulite is proposed in which the spherulite first forms with an initial degree of crystallinity, and then the crystallization continues approaching a limiting degree of crystallinity. The kinetic parameters characterizing this secondary process are determined and their variation with temperature is studied. (auth)

11532 (TID-20076) THE SCATTERING OF LIGHT FROM THIN POLYMER FILMS. V. THEORY FOR SCATTERING FROM ORIENTED POLYMERS. R. S. Stein and T. Hotta (Massachusetts. Univ., Amherst. Polymer Research Inst.). [1962]. Contract [AT(30-1)-2736]. 21p.

The scattering of light from polymers is calculated for various orientations. Correlations in density fluctuations, anisotropy fluctuations, angles, and polarizability direction are considered. (D.C.W.)

11533 (TID-20077) THE SCATTERING OF LIGHT FROM THIN POLYMER FILMS. VI. EXPERIMENTAL STUDIES ON BIAXIALLY ORIENTED POLYETHYLENE. T. Hotta and R. S. Stein (Massachusetts. Univ., Amherst. Polymer Research Inst.). [1963]. Contract [AT(30-1)-2736]. 15p.

Equations for the polarized components of scattering from an oriented polymer are given, and the procedure for evaluating the equation parameters characterizing scattering by a biaxially oriented film is outlined. Numerical values for the parameters were obtained from experimental data. It is concluded that the correlation volume in the biaxial film has a distorted pancake-like shape with its thin dimension in the thin direction of the film. In the film plane, it has elliptical shape, being about 10% larger in the machine direction. The chain orientation is parallel to the film plane. The calculated angular distribution of intensity agrees acceptably well with experimental data. (D.C.W.)

11534 (TID-20115) ANALYSIS OF DIFFUSION OF DYE PATCHES IN THE OCEAN. Technical Report No. CU-8-64. Takashi Ichiye, Hayato Iida, and Noel B. Plutchak (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). Jan. 1964. Contract AT(30-1)-2663. 26p.

The data of dye patch experiments made off New Jersey and on the Bahama Banks are analyzed. The second moment of the concentration distribution increases with square of time in the initial stage and with cube of time later, in agreement with a theory of a two-particle problem. In order to explain the curved trailing part of the dye patches, refraction of a submerged object is treated theoretically. It is found that the effect of refraction may cause a curved image, but the curvature due to refraction is much smaller than actually observed. The vertically differential advection as the main cause of the curved pattern is treated analytically, and the result is applied to computing vertical eddy viscosity from the observed curved trailing portion of dye patches. The mechanism of striated patterns of dye patches is discussed from the point of view of hydrodynamic instability and of rolling up of streak lines. (auth)

11535 (AEC-tr-6292) SOLVED AND UNSOLVED PROBLEMS OF MEASUREMENT PROCESS IN QUANTUM MECHANICS. G. Ludwig. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from p.150-81 of "Werner Heisenberg and Contemporary Physics," Brunswick, 1961. 38p.

Physical problems concerning systems before the measurement, the relation of macrophysics to quantum mechanics, suitable measurement apparatus, and microscopic measurement are investigated. The interpretation of quantum mechanics used is specified. (D.C.W.)

11536 (AEC-tr-6305) SEPARATION OF Cr^{+++}, Mn^{++}, Co^{++} AND Fe^{+++} BY ION EXCHANGE. J. Mikulski and I. Stroński. Translated by J. J. Pinajian (Oak Ridge National Lab., Tenn.), from Isotopen Tech., 2: 69-70(1962). 7p.

The conditions for the sorption and desorption of Cr^{3+}, Mn^{2+}, Co^{2+}, and Fe^{3+} from concentrated hydrochloric acid solution on the strongly alkaline anion exchanger ASD-2 have been investigated with the help of radioactive indicators. (auth)

11537 (AEC-tr-6306) MEASUREMENT OF THE FLOW RESISTANCE OF A DUCT WITH MULTIPLE CONTRACTION OF ITS CROSS SECTION. Václav Dvořák, Joseph Hak, and Jaroslav Vaníček. Translated for Westinghouse Electric Corp., Pittsburgh, from Elektrotech. Obzor, 49: No. 4, 169-73(1960). 9p.

The design of turboalternator stator windings with internal cooling channels requires the determination of the flow resistance of long ducts of rectangular cross section with multiple contraction by inserts. Air flow measurements were made on a duct model, and the results are analyzed. It was found that an approximate solution within a limited range of Reynolds numbers may be obtained by using known expressions for the flow contraction and expansion. (D.L.C.)

11538 (AEC-tr-6309) ON THE KINETICS OF PHOTOCHEMICAL TRANSFORMATIONS AND CONCENTRATION FLUORESCENCE EXTINCTION OF 9-MONOALKYLATED ANTHRACENES. A. S. Cherkasov and T. M. Vember. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Opt. i Spektroskopiya, 4: 203-10(1958). 13p.

The kinetics of photochemical transformations and concentration fluorescence extinction of anthracene, 9-methyl; 9-ethyl; and 9-propylanthracene in ethanol has been studied. It has been found that the concentration fluorescence extinction of these compounds is caused by the occurrence of photochemical reactions. The rate constants of the photochemical reactions, of the fluorescence extinction, and the boundary quantum yields of the photoreaction (fluorescence) have been determined. (auth)

11539 (AEC-tr-6318) SOME NEW OPERATING PRINCIPLES WITH FLUID BEDS. E. Wicke. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Chem. Eng. Sci., 6: 160-9(1957). 15p.

Quantities of heat locally supplied to or produced in fluid beds are very rapidly dissipated. Likewise, gases introduced at a given spot or formed inside the fluid bed by a chemical reaction are thoroughly mixed with the fluidized material. Hence, it is an obvious step to utilize these properties of the fluid bed for stopping rapid chemical reactions and to examine whether unstable intermediate products can thus be isolated. This may be achieved by two methods: (1) the reaction starts outside the fluid bed, which acts as quenching medium; or (2) the reaction proceeds inside the fluid bed with direct participation of the fluidized material. These two principles are explained by means of three practical examples. (auth)

11540 (AEC-tr-6322) DIFFUSION OF ELEMENTS FROM GROUPS III AND V IN SILICON. R. Saintesprit. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from Solid-State Electron., 1: 123-30(1960). 13p.

A study was made of the diffusion of several elements from Groups III and V in silicon at atmospheric pressure. Gallium, boron, and phosphorus are examined in detail. Quantitative results on masking by a silicon dioxide layer, on the impurity evaporation temperature and the nature of the carrier gas are given. The oxidation and reduction phenomena associated with gallium diffusion, as well as the affinity of boron for silicon oxide, are discussed. (auth)

11541 (SC-T-64-42) PHYSICS OF HIGH POLYMERS AND FUNDAMENTAL PHYSICS. F. H. Mueller. Trans-

lated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Kolloid-Z., 123: 66-83(1951). 29p.

An attempt is made to show how to describe the physical behavior of high polymers independently of their macromolecular constitution. The physical method of investigating matter is described and applied to high polymers. The intercoupling condition and its consequences are considered. Thermodynamic considerations in high polymers are given. Special problems of the rubber-elastic state are discussed. Elastomeric, plastic, and other types of behavior are also discussed. The concept of "a statistical filamentary element" is given. The systemization of the states of aggregation is considered. (D.L.C.)

11542 (SC-T-64-43) STATISTICAL ASSESSMENT OF THE BIOLOGICAL DATA ON THE EARLY DETECTION OF OCCUPATIONAL LEAD POISONING. M. Fautrel. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Arch. Maladies Profess. Med. Trav. Securite Sociale, 19: 5-20(Jan.-Feb. 1958). 19p.

The data of Desoille et al (Archives des Maladies Professionnelles, Vol. 16, No. 3, P. 185-196, 1955) on occupational lead poisoning are re-presented without errors and treated statistically. The data include dotted erythrocytes, plumbemia, coproporphrinuria, and globular protoporphyrine. The diagnostic value of the data is discussed. (D.L.C.)

11543 THE ORIGIN OF LIFE ON EARTH AND ELSEWHERE. Melvin Calvin (Univ. of California, Berkeley). Advan. Biol. Med. Phys., 8: 315-42(1962).

The nature of living matter is reviewed and conditions for the production of a living organism from ammonia and phosphoric salts in the presence of light, heat, and electricity are postulated. Theories are reviewed on the composition of the primitive atmosphere on Earth, the evolution of catalysts, mechanisms of energy transfer, molecular crystallization, and the synthesis of amino acids under primitive earth conditions. The possibility of life on other planets is considered briefly. (C.H.)

11544 THE SYMPOSIUM LENS IMPROVED. Berlyn Brixner (Los Alamos Scientific Lab., N. Mex.). Appl. Opt., 2: 1331(Dec. 1963). (LADC-5857)

The computer design of Symposium Lens is reported. The figure of merit was reduced to 0.068 after 14 runs on IBM 7090. (R.E.U.)

11545 INTRODUCTORY LECTURES ON RADIOISOTOPES. [PART] 5. Y. Shimizu. Niigata Igakkai Zasshi, 77: 392-4(1963). (In Japanese)

11546 GUIDE TO RADIOISOTOPES. [PART] 2. Y. Shimizu. Niigata Igakkai Zasshi, 77: 222-5(Apr. 1963). (In Japanese)

11547 INTRODUCTORY LECTURES ON RADIOISOTOPES. [PART] 6. Y. Shimizu. Niigata Igakkai Zasshi, 77: 445-51(Aug. 1963). (In Japanese)

11548 THE JOINT RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY DIGEST, VOL. 4, NO. 3, JULY 1–SEPTEMBER 30, 1963. (United States–Euratom Joint Research and Development Program). 92p. $5.00 per yr. (Euratom). (TID-20035)

A cumulative list of the EURATOM-United States contracts entered into force before September 30, 1963, is presented under the following headings: nuclear fuels, reactor materials, nuclear engineering, reactor physics, and miscellaneous. The scope of programs contracted for during the report period is outlined. Technical progress is reviewed. (N.W.R.)

11549 FUNDAMENTAL NUCLEAR ENERGY RESEARCH, 1963. A Special Report of the United States Atomic Energy Commission, December 1963. (Division of Plans and Reports, AEC). 430p. $2.50(GPO).

Separate abstracts were prepared for the five sections of the report. (D.C.W.)

For abstracts of individual sections see: 9815, 9817, 10215, 11376, and 11550.

11550 BASIC PHYSICAL RESEARCH PROGRAM. p.181-288 of "Fundamental Nuclear Energy Research." Washington, D. C., GPO, 1963.

Some developments in physics, mathematics, chemistry, computers, metallurgy, and controlled thermonuclear research are summarized. (D.C.W.)

11551 ULTRASONIC METHOD OF MEASURING THICKNESS USING LAMB WAVES. Daniel C. Worlton and Charles L. Frederick (to U. S. Atomic Energy Commission). U. S. Patent 3,120,120. Feb. 4, 1964.

A nondestructive method of measuring the thickness of a metal sample using Lamb waves is described. Pulsed ultrasonic waves having a wide frequency spectrum are caused to travel through a coupling medium and strike the test sample at a predetermined angle of incidence. Discrete frequencies within the pulsed ultrasonic waves cause Lamb wave modes to be excited within the test sample, dependent upon the thickness thereof and the velocity of the ultrasonic waves along the surface of the test sample. The excited Lamb waves radiate pulsed ultrasonic waves from the test sample at an angle of exit equal to the angle of incidence of the applied ultrasonic waves. The radiated ultrasonic waves contain only the discrete frequencies that excited the Lamb waves. These discrete frequencies are detected to give a measurement of the thickness of the metal sample. (AEC)

11552 METHOD OF FORMING METAL PLATES WITH EXPLOSIVES. Moroni T. Abegg and R. A. Norwood (to U. S. Atomic Energy Commission). U. S. Patent 3,120,827. Feb. 11, 1964.

The forming of metal plates with explosives in such a manner as to produce uniform-thickness contoured metal products is described. A female die having a depression or depressions and elevations corresponding to the desired configuration is used. A metal plate is laid across the top of the female die, and a sheet of high explosive is disposed in spaced parallel relation above the plate. The volume between the explosive and plate, as well as the cavity, is evacuated. An explosive detonator or initiator system is utilized in which peripheral portions of the explosive are ignited and the explosive travels inwardly into the sheet. Accordingly, a shock wave is produced that approaches and collides first with peripheral portions and proceeds progressively inward. With convoluted or similarly contoured female dies, an ignition system is generally used in which sheet plastic is ignited initially at all points corresponding to the higher portions of the female die. In this manner the shock wave converges from the higher to the lower portions of the die deforming the sheet and producing uniform-thickness contoured sheets. In another modification of the process, a liquid coupling medium may be employed to transmit the shock wave. Complex shapes and contours may be formed in metal plates while maintaining thickness to a high degree of accuracy. (AEC)

11553 NON-REFLECTION TERMINATION OF A COAXIAL CABLE. S. Giordano (to U. S. Atomic Energy Commission). U. S. Patent 3,121,204. Feb. 11, 1964.

A dissipative load for a transmission line carrying

microwave r-f energy is described. The end of the cable is prepared by stripping away a portion of the outer sheath to a length determined by frequency, flaring the sheath, and immersing the prepared end in a solution of particular dielectric characteristics. (AEC)

11554 ELECTRICALLY CONDUCTIVE FLOOR COVERING FOR USE IN EXPLOSIVE HAZARD AREAS. M. T. Abegg, O. D. Bottler, J. D. Deligans, and F. S. Nicholson (to U. S. Atomic Energy Commission). U. S. Patent 3,121,825. Feb. 18, 1964.

A floor covering structure including a composition composed of comminuted aluminum metal in admixture with an epoxy resin and a curing agent and, optionally, a thermoplastic softener, is described. The cured composition in appropriate thicknesses and overlaid upon a grounded conductive sheet possesses a resistance suitable for use in explosive-hazards areas as well as possessing excellent appearance and chemical resistance. (AEC)

11555 A FLUID OPERATED TOOL FOR COUPLING TUBES TOGETHER. Henry J. Bellarts (to U. S. Atomic Energy Commission). U. S. Patent 3,121,941. Feb. 25, 1964.

A tool for joining tubes by means of a multipart tube coupling is described. The tool applies forces to the tubes and coupling in straight lines parallel to the tubes, in spite of the fact that the power for these forces comes from pivoted arms. This is accomplished by special needle bearings, each having an outer race formed of relatively movable segments incompletely enclosing the needles, and also retainers engaging the ends of the needles to keep them in place. (AEC)

11556 MAGNETIC CORE PLANE THREADING MACHINE AND METHOD. J. F. Marine and R. T. Shevlin (to U. S. Atomic Energy Commission). U. S. Patent 3,122,178. Feb. 25, 1964.

A device and a method for threading large numbers of toroidal magnetic cores used as memories in high-speed general purpose digital computers are described. A pair of reciprocating hooks is arranged to have the board with cores embedded therein placed between these hooks. The needles transfer a length of conductor or wire sufficient for a whole row of cores through each successive core while the board is translated with the result that a row of cores is interlaced with the wire in one pass. The board is then translated at right angles to effect the wiring of the next row of cores. (AEC)

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This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

Each entry under a corporate author is a shortened version of the title of the publication, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt.," permitting a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

æ	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is indentifiable by the absence of a report number.

General Indexing Style

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ξ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
Al–Cr ...
CHROMIUM ALLOYS
Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly with cross references under the element components. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
Si–W ...
TUNGSTEN SYSTEMS
Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

In this subject index specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract than would be possible with only a word or two whenever it appears that such information would be useful. Such phrases are written so that the idea considered most important is presented first, should a not-too-awkward expression result. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium—allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been omitted from such phrases provided no ambiguity results from the omission.

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Reports, numbered translations, and patents abstracted during the period are included in this index. Each item is listed by report number; this is followed by the abstract number and a brief notation regarding public availability. The index entries show, when known, which reports are on file in the depository libraries, which reports have been published in open-literature journals (journal citation given), and which reports can be purchased (source and price). Whenever a report is identified by more than one number, cross references from secondary to primary report numbers are cited.

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11	18-11135	ORINS. Gmelin, AED-CONF-63-218-29
12	18-10675	ORINS. Gmelin, AED-CONF-63-218-14
13	18-11158	ORINS. Gmelin, AED-CONF-63-218-13
14	18-10676	ORINS. Gmelin, AED-CONF-63-218-12
CONF-346–	(International Conference on Nuclear Physics with Reactor Neutrons, Argonne, Ill., Oct. 1963)	
7	18-11194	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-201-1
CONF-360–	(American Nuclear Society Topical Meeting, Nuclear Performance Power Reactor Cores, San Francisco, Sept. 1963)	
11	18-11465	ORINS. Gmelin, AED-CONF-63-152-10
CONF-362–	(2nd Symposium on Radiochemistry in Man, Chicago, Sept. 1962)	
1	18-10427	ORINS. Gmelin, AED-CONF-63-172-1
CONF-363–	(International Symposium on Plasma Phenomena, San Diego, Calif., Oct. 1963)	
4	18-10248	ORINS. Gmelin, AED-CONF-63-202-5
13	18-11301	$3.60(fs), $1.31(mf) OTS; AED-CONF-63-202-9
14	18-11355	ORINS. Gmelin, AED-CONF-63-202-10
CONF-364–	(16th Annual Gaseous Electronics Conference, Pittsburgh, Oct. 1963)	
7	18-10799	ORINS. Gmelin, AED-CONF-63-195-8
CONF-373–	(Technical Conference on Applied Aspects of Refractory Metals, Los Angeles, Dec. 1963)	
2	18-10572	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-252-1
CONF-374–	(American Physical Society Southeastern Section, Lexington, Ky., Nov. 1963)	
2	18-11295	ORINS. Gmelin, AED-CONF-63-227-2
CONF-375–	(6th National Symposium, Society for Aerospace Material Process Engineers, Seattle, Nov. 1963)	
4	18-10513	ORINS. Gmelin, AED-CONF-63-224-4
CONF-381–	(International Symposium on Physical Processes in Radiation Biology, Ann Arbor, Mich., May 1963)	
2	18-10765	Dep.(mc); $2.60(fs), $1.01(mf) OTS; Gmelin, AED-CONF-63-247-1
CONF-384–	(Symposium on Radioactivation Analysis and Its Application to the Biological Sciences, Saclay, France, Sept. 1963)	
1	18-9818	See EUR-474.e
CONF-386–	(Mining and Processing Subgroup of the Working Group for Extraterrestrial Resources, Golden, Colo., Sept. 1963)	
1	18-10213	See UCRL-7515
CONF-387–	(1st Australian Conference on Electrochemistry, Sydney, Feb. 1963)	
1	18-10035	Dep.(mc); $1.60(fs), $0.80(mf) OTS
CONF-388–	(64th Annual Meeting of the American Ceramic Society, New York, May 1962)	
1	18-10496	See NMI-TJ-55
CONF-390–	(8th Symposium on Advances in Tracer Methodology, Chicago, Nov. 1963)	
1	18-10175	ORINS. Gmelin, AED-CONF-63-217-2
CONF-391–	(AIAA Heterogeneous Combustion Conference, Palm Beach, Fla., Dec. 1963)	
1	18-11478	New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-488, $1.00. ORINS
2	18-10110	New York, American Inst. of Aeronautics

Report No.	Abstract No.	Availability
		and Astronautics, 1963, Preprint 63-485, $1.00. ORINS
3	18-10493	New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-493, $1.00. ORINS
CVNA–	**(Misc.)**	
198	18-11431	Dep.(mc); $4.60(fs), $1.46(mf) OTS
D–	**(Misc.)**	
1-82-0239	18-10623	$8.10(OTS)
2-9878-4	18-10374	
DASA–	**(Misc.)**	
1386	18-10261	$15.50(OTS)
DEG-Inf. Ser.–	**(British)**	
266	18-11380	Dep.(mc)
DMIC–	**(Non-AEC)**	
190	18-10526	$4.00(OTS)
DP–		
843	18-10301	Dep.; $2.75(OTS)
847	18-10179	Dep.; $0.75(OTS)
875	18-11432	Dep.; $1.00(OTS)
DPWR–		
318	18-10452	See TID-20058
DRCL–	**(Canadian)**	
401	18-10274	Dep.(mc)
DRI–	**(Misc.)**	
2139	18-10036	Dep.(mc); $1.60(fs), $0.80(mf) OTS
DUBNA REPORTS–	**(Russian)**	
See JINR (Russian)		
EANDC(E)–	**(European-American Nuclear Data Committee)**	
49(L)	18-11195	Dep.(mc)
EE–	**(Misc.)**	
21	18-11306	See USCEC-96-101
EFINS–	**(Misc.)**	
63-57	18-10755	J. Geophys. Res., 69: 505-20(1964)
EIR–	**(Swiss)**	
58	18-10115	Dep.(mc)
EU-B–	**(German)**	
26	18-10457	For translation see EURAEC-875
EUR–	**(European Atomic Energy Community)**	
345.e	18-10037	Dep.(mc)
412.f	18-10116	Dep.(mc)
425.i	18-11433	Dep.(mc)
430.i	18-10335	Dep.(mc)
474.e	18-9818	Dep.(mc)
492.d	18-10117	Dep.(mc)
521.e	18-11410	Dep.(mc)
EURAEC–		
432	18-10546	Dep.(mc); $7.60(fs), $2.60(mf) OTS
733	18-10456	Dep.(mc); $3.60(fs), $1.13(mf) OTS
739	18-10500	Dep.(mc); $4.60(fs), $1.64(mf) OTS
761	18-10052	Dep.(mc); $1.60(fs), $0.80(mf) OTS
787	18-10501	Dep.(mc); $11.00(fs), $4.52(mf) OTS
788	18-10502	Dep.(mc); $5.60(fs), $1.82(mf) OTS
812	18-10470	Dep.(mc); $2.60(fs), $1.10(mf) OTS
813	18-10503	Dep.(mc); $5.60(fs), $1.94(mf) OTS
815	18-11413	Dep.(mc); $3.60(fs), $1.13(mf) OTS
832	18-11452	Dep.(mc); $1.60(fs), $0.80(mf) OTS
849	18-10504	Dep.(mc); $11.00(fs), $4.58(mf) OTS
853	18-10505	Dep.(mc); $6.60(fs), $2.03(mf) OTS
855	18-10224	Dep.(mc); $2.60(fs), $1.01(mf) OTS
857	18-10225	Dep.(mc); $4.60(fs), $1.43(mf) OTS
858	18-10226	Dep.(mc); $1.60(fs), $0.80(mf) OTS
864	18-10475	Dep.(mc); $8.10(fs), $2.81(mf) OTS
875	18-10457	Dep.(mc); $1.60(fs), $0.80(mf) OTS
877	18-10384	Dep.(mc); $3.60(fs), $1.13(mf) OTS
927	18-10205	See ACNP-63035
936	18-10522	See BMI-X-10072
939	18-10036	See DRI-2139
941	18-11434	See GEAP-4486
944	18-11411	See GEAP-3771-11
945	18-10227	See GEAP-4429
946	18-10521	See ATL-A-140
948	18-10250	See SWRI-1296-6-8
967	18-11192	See BAW-1286
968	18-11396	See ACNP-64003
FFIF-TN–	**(Norwegian)**	
F-61	18-10375	Dep.(mc)
FTD-TT–	**(Non-AEC)**	
62-355	18-9836	OTS
62-1692	18-9933	OTS
63-455	18-11475	OTS
63-581	18-9914	OTS
FZK–	**(Non-AEC)**	
9-191	18-11512	See NARF-63-9p
FZM–	**(Non-AEC)**	
2822	18-10275	$17.50(OTS)
2911	18-10262	See CONF-209-21
GA–	**(Misc.)**	
4812	18-11145	Dep.(mc); $1.60(fs), $0.80(mf) OTS
GEAP–	**(Misc.)**	
3771-11	18-11411	Dep.(mc); $5.60(fs), $1.94(mf) OTS
4296	18-10573	Dep.(mc); $3.60(fs), $1.28(mf) OTS
4359	18-10574	Dep.(mc); $7.60(fs), $2.60(mf) OTS
4429	18-10227	Dep.(mc); $4.60(fs), $1.46(mf) OTS
4486	18-11434	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HEPL–	**(Misc.)**	
170	18-10979	Dep.(mc); $6.60(fs), $2.24(mf) OTS
HW–		
66266(Suppl.1, Rev.)	18-10302	Dep.; $1.25(OTS)
66921	18-10448	Dep.(mc); $1.10(fs), $0.80(mf) OTS
67437	18-10471	Dep.(mc); $1.60(fs), $0.80(mf) OTS
76246	18-10527	Dep.(mc); $3.60(fs), $1.37(mf) OTS
76246(App.2)	18-10528	Dep.(mc); $3.60(fs), $1.13(mf) OTS
76246(App.3)	18-10529	Dep.(mc); $2.60(fs), $0.89(mf) OTS
76246(App.4)	18-10530	Dep.(mc); $1.60(fs), $0.80(mf) OTS
76246(App.5)	18-10531	Dep.(mc); $2.60(fs), $1.04(mf) OTS
76246(App.6)	18-10532	Dep.(mc); $1.60(fs), $0.80(mf) OTS
76246(App.7)	18-10533	Dep.(mc); $2.60(fs), $0.92(mf) OTS
79054	18-10624	Dep.; $2.25(OTS)
79127	18-10336	Dep.; $0.50(OTS)
79159	18-11483	Dep.(mc); $1.60(fs), $0.80(mf) OTS
79205	18-10216	Dep.; $1.00(OTS)
79275	18-11484	Dep.(mc); $1.60(fs), $0.80(mf) OTS
79336	18-11485	Dep.(mc); $1.60(fs), $0.80(mf) OTS
79354	18-10038	Dep.(mc); $1.10(fs), $0.80(mf) OTS
79652	18-10303	Dep.; $1.00(OTS)

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80391	18-11412	Dep.(mc); $1.60(fs), $0.80(mf) OTS
80523	18-10228	Dep.(mc); $4.60(fs), $1.52(mf) OTS
HW-SA–		
3013	18-11403	Nucl. Sci. Eng., 18: 116-25(1964)
3123	18-10066	Inorg. Chem., 3: 211-14(1964)
3282	18-10180	Dep.(mc); $1.60(fs), $0.80(mf) OTS
IA–	(Non-AEC)	
795	18-11437	Dep.(mc)
IDO–		
10039	18-11381	Dep.(mc); $12.00(fs), $5.12(mf) OTS
14619	18-10181	Dep.; $0.50(OTS)
16907	18-11382	Dep.; $0.75(OTS)
16911	18-9961	Dep.; $1.75(OTS)
16917	18-11508	Dep.; $1.25(OTS)
16927	18-11509	Dep.(mc); $1.60(fs), $0.80(mf) OTS
IITRI–	(Misc.)	
A6027-9	18-11197	Dep.(mc); $3.60(fs), $1.34(mf) OTS
B247-12	18-10449	$3.60(OTS)
IKF–	(German)	
7	18-10682	Dep.(mc)
10	18-10377	Dep.(mc)
INSJ–	(Japanese)	
64	18-10844	Dep.(mc)
IPST-Cat.–	(Russian)	
969	18-10462	For translation see OTS-63-11098(Vol.I)
IS–		
663	18-10086	Phys. Chem. Solids, 24: 1405-18(1963)
679	18-10124	Inorg. Chem., 3: 242-5(1964)
737	18-9969	Dep.; $2.50(OTS)
739	18-10039	Dep.; $1.75(OTS)
777	18-9970	Dep.; $1.00(OTS)
JAERI–	(Japanese)	
1048	18-11500	
7027	18-11510	
JINR–	(Russian)	
P-1222	18-11198	Dep.(mc)
P-1445	18-11199	Dep.(mc)
P-1446	18-10980	Dep.(mc)
P-1448	18-10683	Dep.(mc)
P-1449	18-10684	Dep.(mc)
P-1452	18-11200	Dep.(mc)
P-1454	18-10845	Dep.(mc)
P-1455	18-10182	Dep.(mc)
P-1456	18-11201	Dep.(mc)
P-1458	18-10846	Dep.(mc)
P-1459	18-10981	Dep.(mc)
P-1460	18-10446	Dep.(mc)
P-1461	18-10847	Dep.(mc)
P-1462	18-10848	Dep.(mc)
P-1464	18-11202	Dep.(mc)
P-1467	18-10849	Dep.(mc)
P-1469	18-10850	Dep.(mc)
P-1473	18-10982	Dep.(mc)
P-1474	18-10851	Dep.(mc)
P-1484	18-10852	Dep.(mc)
P-1485	18-10983	Dep.(mc)
P-1488	18-10685	Dep.(mc)
JPRS–	(Non-AEC)	
22697	18-10458	$3.00(OTS)
22702(Del.)	18-10279	OTS
22778	18-9837	$0.50(OTS)
23279	18-10439	$0.50(OTS)
JÜL–	(German)	
139-ST	18-10304	Dep.(mc)
K–		
1593	18-10337	Dep.; $0.50(OTS)
KAPL-M–		
FDF-4	18-10766	Dep.(mc); $1.10(fs), $0.80(mf) OTS
KR–	(Norwegian)	
62	18-10229	Dep.(mc)
LA–		
2995	18-10534	Dep.; $0.75(OTS)
LADC–		
5856	18-10757	J. Geophys. Res., 69: 564-5(1964)
5857	18-11544	Appl. Opt., 2: 1331(1963)
5864	18-10349	Appl. Opt., 2: 1281-6(1963)
5931	18-10756	J. Geophys. Res., 69: 521-4(1964)
6008	18-10559	J. Opt. Soc. Am., 54: 265-6(1964)
LNF–	(Italian)	
62/114	18-10853	Dep.(mc)
63/47	18-10625	Dep.(mc)
63/54	18-10800	Dep.(mc)
63/67	18-11100	Dep.(mc)
63/78	18-11101	Dep.(mc)
63/79	18-11102	Dep.(mc)
63/83	18-11103	Dep.(mc)
MATT–		
220	18-11337	Phys. Rev. Letters, 12: 6-9(1964)
228	18-10495	Dep.(mc); $2.60(fs), $0.86(mf) OTS; Gmelin, AED-CONF-63-161-47
MIT–	(Misc.)	
1965-3	18-10040	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ML–	(Misc.)	
1087	18-11301	See CONF-363-13
1126	18-11305	See TID-20055
MSAR–	(Misc.)	
63-133	18-10305	
64-6	18-10472	Dep.(mc); $3.60(fs), $1.40(mf) OTS
N–	(Misc.)	
63-18835	18-10535	
NAA-SR–		
8514	18-10230	Dep.; $0.50(OTS)
8515	18-10218	Dep.; $1.00(OTS)
8881	18-11511	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9009	18-11486	Dep.; $1.75(OTS)
9010	18-10231	Dep.; $2.00(OTS)
9163	18-11383	Dep.; $1.50(OTS)
NAA-SR-Memo–		
8499	18-10536	Dep.(mc); $13.00(fs), $5.75(mf) OTS
9015	18-10537	Dep.(mc); $4.60(fs), $1.43(mf) OTS
NARF–	(Non-AEC)	
63-9p	18-11512	$16.00(OTS)
NIRL-R–	(British)	
53	18-11104	Dep.(mc); $2.00(BIS); 10s. (HMSO)

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NMI-TJ–		
55	18-10496	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NP–	**(AEC File No. for Non-AEC Reports)**	
13511	18-10340	Dep.(mc)
13512	18-9940	Dep.(mc)
13522	18-10726	
13526	18-11302	Dep.(mc)
13539	18-11513	
13541	18-11215	Dep.(mc)
13550	18-10727	
13561	18-11216	
13571	18-10626	
13586	18-10265	
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
1089	18-9941	Dep.(mc); $3.60(fs), $1.28(mf) JCL
1093	18-10119	Dep.(mc); $1.60(fs), $0.80(mf) JCL
NRL-Memo–	**(Misc.)**	
1486	18-11487	
NUS–		
168	18-11473	Dep.(mc); $6.60(fs), $2.12(mf) OTS
NYO–		
9774	18-10306	Dep.; $0.50(OTS)
10492	18-11384	Dep.(mc); $6.60(fs), $2.03(mf) OTS
10565	18-10876	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ORA–	**(Misc.)**	
4915-1-F	18-10342	See RADC-TDR-63-54
5000-6T	18-11296	See AD-404520
ORNL–		
3415	18-11514	Dep.(mc); $8.60(fs), $3.08(mf) OTS
3502	18-11515	Dep.(mc); $9.10(fs), $3.26(mf) OTS
ORNL-TM–		
462(Rev.1)	18-10065	Inorg. Chem., 3: 189-95(1964)
659	18-10447	Dep.(mc); $2.60(fs), $0.83(mf) OTS
736	18-10438	Dep.(mc); $3.60(fs), $1.13(mf) OTS
746	18-10473	Dep.(mc); $1.10(fs), $0.80(mf) OTS
747	18-10041	Dep.(mc); $1.10(fs), $0.80(mf) OTS
750	18-9971	Dep.(mc); $9.60(fs), $3.53(mf) OTS
777	18-10118	Dep.(mc); $1.10(fs), $0.80(mf) OTS
778	18-11488	Dep.(mc); $1.60(fs), $0.80(mf) OTS
OTS–	**(Misc.)**	
63-11098(Vol.I)	18-10462	$3.50(OTS)
64-21263	18-10458	For translation see JPRS-22697
64-21267(Del.)	18-10279	For translation see JPRS-22702(Del.)
64-21316	18-9837	For translation see JPRS-22778
64-21586	18-10439	For translation see JPRS-23279
PATENTS	**(German)**	
1,152,684	18-10514	
1,152,999	18-10445	
1,153,121	18-10428	
1,153,195	18-10429	
1,153,464	18-11365	
1,156,905	18-11391	
1,160,117	18-11356	
PATENTS	**(U. S.)**	**$0.25 each, U. S. Patent Office**
3,117,914	18-11420	
3,117,836	18-10114	
3,117,842	18-10430	
3,117,913	18-11419	
3,118,083	18-10360	
3,118,222	18-10515	
3,118,819	18-11421	
3,118,820	18-10177	
3,119,013	18-10030	
3,119,016	18-10431	
3,120,120	18-11551	
3,120,435	18-10204	
3,120,470	18-11159	
3,120,476	18-11357	
3,120,477	18-11358	
3,120,480	18-11392	
3,120,481	18-11359	
3,120,493	18-11504	
3,120,827	18-11552	
3,121,034	18-10465	
3,121,045	18-11393	
3,121,046	18-11394	
3,121,047	18-11422	
3,121,128	18-10516	
3,121,204	18-11553	
3,121,666	18-11423	
3,121,825	18-11554	
3,121,941	18-11555	
3,122,027	18-10222	
3,122,178	18-11556	
3,122,414	18-11505	
3,122,424	18-10517	
3,122,458	18-10570	
3,122,484	18-11395	
3,122,509	18-11424	
3,122,595	18-11425	
3,122,648	18-10361	
PATENTS	**(U.S.S.R.)**	
155,250	18-10838	
PHRO-DEV–		
119	18-10276	Dep.(mc); $1.10(fs), $0.80(mf) OTS
PPAD–		
506D	18-10877	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PWAC–	**(Misc.)**	
385	18-11474	Dep.; $0.75(OTS)
RADC-TDR–	**(Misc.)**	
63-54	18-10342	$9.10(OTS)
RFP–		
356	18-10450	$2.60(fs), $1.01(mf) OTS
358	18-9972	Dep.(mc); $1.60(fs), $0.80(mf) OTS
RHD–	**(Non-AEC)**	
Vol.IV,No.12	18-10329	$0.50(GPO)
RMO–		
3005	18-10206	Dep.(mc); $3.60(fs), $1.22(mf) OTS
RT-EL–	**(Italian)**	
(63)-5	18-11385	Dep.(mc)
RT-ING–	**(Italian)**	
(63)-20	18-11438	Dep.(mc)
RTD-TDR–	**(Non-AEC)**	
63-3076	18-10767	
63-4096(Pt.I)	18-10539	OTS
63-4236	18-10497	$6.60(OTS)
SB–	**(Non-AEC)**	
63-9	18-10518	See AD-410526

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SC–	(Misc.)	
4959(M)	18-11516	Dep.; $0.50(OTS)
SC-T–		
64-42	18-11541	Dep.(mc); $2.60(fs), $1.07(mf) JCL
64-43	18-11542	Dep.(mc); $1.60(fs), $0.80(mf) JCL
SC-DC–		
64-268	18-10381	Dep.(mc); $1.60(fs), $0.80(mf) OTS
64-278	18-11517	Dep.(mc); $7.60(fs), $2.48(mf) OTS
64-291	18-11518	Dep.(mc); $12.00(fs), $5.03(mf) OTS
SCL-TM–		
64-1	18-11519	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SIT–		
110	18-11304	Dep.(mc); $6.60(fs), $2.15(mf) OTS
SIT-P–	(Misc.)	
78	18-10343	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SLAC–		
25(Pt.I)	18-10696	Dep.; $3.00(OTS)
STI-PUB–	(International Atomic Energy Agency)	
71(p.255-81)	18-10234	For translation see AEC-tr-6303
SWRI–		
1296-6-8	18-10250	Dep.(mc); $2.60(fs), $0.98(mf) OTS
5-1348-7-2	18-11439	Dep.(mc); $1.10(fs), $0.80(mf) OTS
TID–		
3721	18-11520	Dep.; Free (DTI Extension)
4202	18-10432	Dep.; $2.25(OTS)
7672	18-11440	Dep.; $5.50(OTS)
7675	18-10042	Dep.; $2.75(OTS)
17992	18-11521	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19108	18-10307	Dep.(mc); $4.60(fs), $1.49(mf) OTS
19417	18-10926	Nuovo Cimento (10), 31: 113-31(1964)
19926	18-11522	Dep.(mc); $1.10(fs), $0.80(mf) OTS
19927	18-11523	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19937	18-11524	Dep.(mc); $3.60(fs), $1.19(mf) OTS
19999	18-9973	Dep.(mc); $9.10(fs), $3.23(mf) OTS
20007	18-10344	Dep.(mc); $6.60(fs), $2.21(mf) OTS
20024	18-10540	Dep.(mc); $3.60(fs), $1.31(mf) OTS
20026	18-10451	Dep.(mc); $4.60(fs), $1.46(mf) OTS
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